PSYCHOLOGY

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Preface

In recent years there has been an increasing demand that the first course in psychology be made functional in the life of the student. If the demand were met in full, the psychologist would be expected to deal with the worries and little problems of the student and forego any attempt to deal with scientific data and principles. Naturally, the psychologist has resisted such an extreme demand. It does seem, however, that the first course is a legitimate place for the application of principles of human behavior to everyday life. I have attempted, therefore, to present the subject in the language of the student so far as possible and to keep discussion close to the student's world. At the same time I have attempted to acquaint him with the methods of scientific investigation in this field, including the development of generalizations or principles.

The psychologist knows only too well that rules of human conduct cannot or should not be laid down as scientific dicta, as is too frequently expected by the outsider. It is the aim of this text first to help the student to understand human behavior, and second to encourage him to practice those principles which apply to his own case. The latter is the most difficult phase of the course. Students may learn about behavior, but fail to master the techniques or skills for putting the principles into effect. Such training cannot be put into a textbook. It can, however, be facilitated in the classroom by the instructor who is interested in making his subject work.

At the outset it was my intention to include the usual chapter on social behavior. This subject, however, has been absorbed in other chapters. Psychology is not only biological; it

is also social. Language, motives, learning, emotion—all have their social origin as well as their social influence. The chapter on heredity has been included to satisfy the students' repeated inquiries. I realize that we are not on secure ground here, but I offer no apology.

A variety of test items, principally true-false, are provided for each chapter. Most instructors make use of objective examinations, and students are always eager to get samples. The incentive thus afforded should, with a bit of encouragement, induce the students to make use of them.

I am indebted to all the junior staff at the Ohio State University for their numerous suggestions and often severe criticisms. Professor Kenneth H. Baker read the manuscript while it was in process. My former associate, Professor Willard L. Valentine, read the completed manuscript. Both made valuable contributions. To Dr. Brent Baxter and Dr. James S. Karslake I am indebted for preparation of the test items. Professor Oliver A. Ohmann, Western Reserve University, and Professor Roger Bellows, University of Maryland, contributed important suggestions before the writing of the manuscript was undertaken. Due credit is given to authors and publishers for borrowed material at the point where it appears in the text. Two unintentional omissions of acknowledgment occurred: Figures 14 and 15 were adapted from several figures in *Biological Basis of Human Nature,* by H. S. Jennings, published by W. W. Norton and Company.

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Unlike his first contact with other subjects in the curriculum, the college student's introduction to the study of psychology is complicated by his own background. Psychology attempts to tell him something about people, and yet he already knows about people. He knows, for example, what joy and sorrow are; and he has learned to group these and many other experiences in his life into one class, which he calls *emotions*. He has learned also that work results in fatigue; that certain acts bring disastrous results and are therefore to be avoided. He knows, although he may not state this fact in precise terms, that it is essential to make friends and to learn how to get along with people. We frequently hear the doctor or the lawyer or the businessman say that he "uses" psychology in his profession or business, although he may never have studied psychology. He means, of course, that he is dealing with people, and that he is adjusting his behavior to their beliefs and interests. This, then, is the subject matter of psychology with which the student is already somewhat familiar when he begins his study of it. He has been living with other human beings and, hence, has acquired some notion of the "mind and manner of man."

Along with the knowledge of human nature that he has gained from everyday experience, he has accumulated many ideas that have no scientific basis but are simply pat phrases that sound significant: "You can't trust a blonde." "Artists are temperamental." "Chess playing helps to develop your

power of concentration." "Men are more punctual than women." "You can't teach an old dog new tricks." "If a person uses enough will power, he can do anything." These and literally hundreds of other generalizations like them have sprung from everyday contacts with other human beings. What can a course in psychology add?

Students can expect at least three things from their beginning course in psychology. They can expect: (1) to find that some of the things they "knew" about people are wrong; (2) to learn some things they never knew before; (3) to acquire some help in systematizing what they already know, so that it will be of some value to them in their contacts with their friends and associates. The first point will be the most difficult for them to reconcile. It is always disturbing to learn that something we have believed in for a long time either is not true or is, at best, only a part-truth. Usually, these misconceptions come from a lack of experience. As we broaden the range of our contacts, we learn that some of our pet theories are inadequate and have to be revised to fit the new experiences. This sort of thing happens time and again in our notions concerning matters of government, business, biology, geography, and other fields of interest and study. Students should not be surprised to see it happen, also, in psychology. They may be a little disturbed to learn that some of the things they "know" about people are the result either of inaccurate observation on their part or of observations made on only a few people—their friends, perhaps—who may not be representative of people in general.

Contributions of psychology

What do students hope to get out of a course in psychology? From the responses to this question, it is clear that students are interested in learning about:

1. *The nature of personality.* This includes the development of a good personality as well as methods of studying the personality of other individuals.

2. *Emotion and its control.* Some emotions seem detrimental, while others seem desirable. Worries confront every stu-

dent. Pleasure and the enjoyment of life are important goals for everyone.

3. *Learning and remembering.* Here are problems close to the hearts of all students, because one of their major tasks is the mastery of the content of their various courses. In fact, a great deal of living seems to consist of learning, remembering, and forgetting.

4. *Interests, desires, ambitions.* Students are constantly concerned with such problems as loss of interest in study, the desire to attain success in some chosen field, or a failure to see where their efforts are leading them.

5. *Choosing a vocation.* This problem is closely related to the preceding one. "Can I get any help from psychology in the matter of deciding whether I should study to be a lawyer, doctor, or businessman?"

6. *Things in general.* We want to know just for the sake of knowing. Motivated by curiosity, we would like to know more about ourselves and about other human beings. We study geology or astronomy just to know something about the earth's formation, or to learn what the astronomer can tell us about the stars and planets. We are likewise interested in mankind. "How do you account for this experience I had?" "What makes him do that?" "Is there such a thing as telepathy?"

Some important difficulties

We have already seen that the student *thinks* that he knows a great deal about psychology. UNLESS ADEQUATE PRECAUTIONS ARE TAKEN, PART-INFORMATION AND MISINFORMATION MAY ACTUALLY SERVE AS HINDRANCES TO THE ACQUISITION OF NEW FACTS AND PRINCIPLES. Prejudices once established are hard to overcome. This is particularly true when we appear to get along very well with our beliefs in spite of their falsity.

For example, most fishermen use a great variety of artificial flies of many colors and color combinations when casting for trout. Now it has been definitely established that trout cannot see these colors below the surface of the water. But try to tell some fishermen that. Even if they accept the evidence,

they will go on trying one color after another until they "find the right fly." There is an important lesson to be learned here. We find that, even after all the evidence is assembled and accepted, we still are tempted to operate under many of our former beliefs. It is difficult to give up our old beliefs and our old ways of doing things, in spite of the new evidence that we accept momentarily.

Another important item should be noted at this point: ADJUSTMENT TO ONE'S SURROUNDINGS IS LARGELY A MATTER OF HABIT, AND HABITS ARE ACQUIRED THROUGH PRACTICE. If you read an article on how to make friends, you will not improve your social relations unless you *practice* what you have read. You cannot learn to play golf by reading a book on the subject; a young lady cannot walk gracefully by reading an article in a woman's journal that gives the rules. It is necessary to practice these things, usually many times, until you are able to do what the instructions say. Many psychologists violate most of the principles of psychology because they never have adopted them in their private lives as part of their repertoire of habits. For example, they know that the child profits more from praise than from blame, yet they may be unreasonable in their criticism and punishment of their own children. Also, they know all the principles involved in the control of emotion, but they themselves lose their heads in emotion-provoking situations. They may even exhibit undesirable personality traits which they urge their students to correct in themselves.

Psychology is the most intimate of the sciences. It concerns our thoughts and feelings, our manners and our prejudices; and we do not like to have these disturbed. We can accept changes in anything that does not concern us too intimately. We may accept a new political or economic ideology in Asia or in Europe, but let it come home to us, and it is a different matter. We have our own customs and mores, and although we may recognize our faults, change in the more personal matters is always resisted. This principle operates even in the development of the sciences. Those sciences that do not touch our personal lives were developed first. It is not a mere accident that astronomy was the first science to be de-

veloped and that psychology was one of the last. The sun and the stars are too far away to matter much, so that we can accept the astronomer's discoveries without undue resistance, although even these were accepted with great reluctance at first because of their "revolutionary" nature. But our previously conceived notions about our inner lives are very dear to us, and we therefore continue to be ruled by sentiment.

Terminology versus understanding

Another difficulty that frequently interferes with clear understanding is the assumption that, when we have assigned a name to an event, we have thereby explained the phenomenon. NAMING IS NOT EXPLAINING. A person who persistently steals, regardless of any need for the articles stolen, is called a *kleptomaniac*. Although this is only a term expressing the fact that a person persistently steals, it is often used as an explanation. "Ruth can't stop stealing *because* she is a kleptomaniac." This use of the term tells us nothing.

A college senior's closets were found filled with stolen goods —clothing, jewelry, books, and money. The student was unquestionably a kleptomaniac, but why? Investigation finally revealed that, as an adolescent, she had been considerably upset by the stories told her by an older girl who frequently stole. This particular emotion and stealing had become very intimately related. Now she was worrying about similar experiences, and this worry again (or still) was associated with stealing. Such a method of describing the girl's behavior leaves the door open to treatment. We may treat her tendency to steal as a habit, and help her break this habit in the same way that we would go about breaking other undesirable habits. If we had been satisfied with saying that she stole because she was a kleptomaniac, there would have been little we could have done to help her.

We frequently hear statements like: "John's behavior is due to an inferiority complex." It may be that the person in question keeps in the background; that he hesitates to voice his own opinion; that he blushes easily; and that, in other ways, he demonstrates an unfortunate social awkwardness. On the

other hand, another person talks on all occasions; he shoulders his way to the front in any group and, in general, makes himself disagreeable to others. The terms "inferiority complex," "superiority complex," or "compensation" tell us absolutely nothing about the causes or backgrounds of these behavior patterns. They make convenient labels, but labels are not explanations.

Here is one concrete example, although not all the facts of the case are known. A student was restless and noisy in class; he scoffed at whatever was said by the other students and by the instructor; he was cynical in his attitude and did poorly in his work. After several interviews with him, in which the instructor attempted to discover the background of his behavior, it was revealed that, as a boy, this student had never gotten along with his dominating and unreasonable father. Finally, the boy left home, but soon got into difficulty with the police. Now, after two years in the reformatory, he was in college trying to make a new start, but with the knowledge of his record worrying him. Discovery of these facts constitutes at least a partial explanation of his behavior, but to have said that the boy was compensating for an inferiority complex would simply have been another way of saying that he was not getting along well with his instructor and fellow students. Incidentally, this particular student, through the help of his instructor, did become more satisfactorily adjusted. His manner became more agreeable, and his grades improved.

Description and explanation

We say that we have a partial explanation of the student's behavior. This explanation may be sufficient for some purposes. In this case it was sufficient, for the instructor was able to help this student modify his attitude and improve in his work. However, we do not have a complete explanation. Why did the student fail to get along with a dominating father? Some boys do get along with such parents. Why did he get into trouble when he left home? Others manage to stay out of trouble. Why did he become aggressive instead of submissive? We would need to know more about the boy's background in order to answer these questions

THESE QUESTIONS ARE SUFFICIENT, HOWEVER, TO SHOW THAT AN EXPLANATION IS REALLY A DESCRIPTION OF PRECEDING EVENTS, AND THAT AN EXPLANATION IS NEVER FINAL UNLESS IT CAN GO BACK TO AN ULTIMATE CAUSE. We explain one event, not by assigning a name to it, but by describing preceding events. These events, in turn, need to be explained by describing their antecedents. A three-year-old child asks: "What makes the engine go?" He is satisfied when he is told: "The man puts coal in it to make it go." Later, this explanation is not adequate, and he must be told that the energy stored in the coal is released as heat by the process of combustion; that this heat is transferred to the water, which expands into steam; and that, finally, the energy is transmitted to the pistons. A series of events has been described. It is such a series of descriptions that make up an explanation.

The Scientific Method

The chief characteristic of the scientific method is the requirement that the observer be trained to distinguish what he observes from what he would like to infer. The observer's prejudices or preconceived notions must be kept out of the investigation. It is true that no scientist is entirely free from bias, but his training has provided him with methods whereby he checks his observations to make sure that his facts are adequate.

The following excerpts from two reports will illustrate what is meant. Two students were instructed to go shopping together and take careful notes on their observations.

A reported:

1. The clerk was certainly not cut out for a saleslady.
2. I told her what I wanted, but she brought me something else.
3. She contradicted me several times.

B reported:

1. *A* frowned, and her lip curled.
2. The clerk brought one coat that answered the description and two others.
3. *A* and the clerk disliked each other.

A's first statement is an inference or judgment of salesmanship. Her second statement represents an observation, but it does not agree with *B*'s second note. *B*, on the other hand, makes a statement of observation (1) and then one of inference (3). Looking at all six statements, we may *infer* that *A*'s second statement was inaccurate because of bias against the clerk.

Fact and theory

It is commonly believed that there is a sharp distinction between fact and theory. "We want facts, not theories." BUT IN SCIENCE, A "THEORY" IS SIMPLY AN INTERPRETATION OF FACT—USUALLY A GROUP OF RELATED FACTS. Thus, it happens that the same group of facts may have different theories attached to them. One person examines the facts of the development of the various branches of the animal kingdom and interprets them in the light of a "theory of evolution"; another person examines the same facts and interprets them in terms of another theory. The facts themselves cannot be denied, but the theory that the facts substantiate is a matter of choice. This is an important point to remember. Here we will be a great deal more concerned with presenting facts than with presenting theory.

There was a time in psychology when theory played a much more important role than it does today. At that time, there were large gaps in our knowledge about human behavior, and the few facts that had been established could be made to fit into almost any theory one cared to select. This is not the case today. So many facts about our behavior have been assembled that the choice of theories which *all* of these facts will fit is much narrower. The particular theory that you adopt is not especially important, provided your theory does not omit any of the facts that have been established so far. This point must be remembered. AN ADEQUATE THEORY TAKES ALL OF THE PERTINENT FACTS INTO ACCOUNT. If you intentionally close your eyes to certain facts or fail to modify your theory in the light of newly discovered facts, you have committed an unforgivable scientific sin.

Hypothesis

It not infrequently happens in our everyday adjustment that questions arise which *must* be answered. Sometimes there are no facts available upon which we can base an answer. It is then that we make the best possible guess, or hypothesis. We cannot maintain that our hypothesis will always be true, but we can make the shrewdest guess possible by taking into account as much as possible of what we know. A good hypothesis will bear some kind of logical relationship to our own past experience, and that is why we sometimes call these guesses *horse sense* or *common sense.* These terms mean simply that, if such and such is true (fact), then so and so must be true (hypothesis).

The fact that so many of these shrewd guesses have turned out to be true has led many people to accept some hypotheses uncritically. It has been somewhat disturbing to discover that mere logic is not an absolute guarantee of truth. There was a time when the hypothesis that women were capable of playing an effective role in government and business was laughed off as being senseless, illogical, and impossible. It was easy to demonstrate that woman's place was in the home; that she had no head for business; that she could make no contribution to government. The "logic" of this hypothesis has not stood the test of time.

At another time in our history, it was logical to conclude that the earth was flat. This hypothesis has also failed to stand up under test. While it is conventional for us to smile as we read about these landmarks in the development of science, we must remember that, *at the time they were given,* these guesses were the best that could be made. They were good common sense, and any straight-thinking person would accept them as such. As mentioned earlier, on the other hand, some of the guesses have turned out to be true. Grandmother, for instance, used to say that an hour of sleep before midnight is worth two hours after midnight. This guess has been shown to be true in the sense that going to bed an hour later than usual is much more harmful than getting up an hour earlier than usual.

Before a hypothesis has been submitted to experimental test, it is conventional to call it a *working hypothesis*—that is, the hypothesis lays the groundwork for the experiment or observations that are designed to prove or disprove it. The important thing to remember here is that the hypothesis is temporary; that we may not call it either true or false until we have put it through the mill of scientific test. This hypothesis then becomes a theory. Thus, we have a theory of color vision, a theory of emotion, a theory of rote learning, and so forth. These are not mere verbalizations of the armchair variety but organizations of facts, as the facts are now known, even though further investigations may make modifications or rejection necessary.

Scientific proof

Scientific proof is a definite method sharply distinguished from historical proof or proof in the popular sense. The scientist must formulate conditions under which the phenomena may be observed by anyone who has adequate scientific training.

The adherence to scientific proof in psychology excludes the armchair method—animal stories, casual observations, and any reference to one's own experience that cannot be duplicated by another. The mere statement that a certain thing happened under certain circumstances is inconclusive, because no one can ever be certain that the description of the circumstances is sufficiently comprehensive—that is, that certain details are not omitted from the account or that certain details specified are not erroneous.

Lloyd Morgan relates that, on one occasion, he threw a stick over the fence; whereupon his dog, who had learned to retrieve the stick, slipped through a hole in the hedge, picked up the stick, and started to return with it. As he had seized it by the middle, it would not go through the hole. Time after time he dropped it, only to pick it up again and make for the hole. Finally, he seized the stick nearer one end and was able this time to drag it through the hole. A passer-by, who witnessed only the last performance, remarked on the wisdom of the dog

who was able to judge the best way of getting a long stick through a small hole. This man lacked the information regarding the previous history of this dog, as well as complete data regarding the present circumstance; and he was also burdened with preconceived notions about the intelligence of dogs in general that would make correct interpretation of the facts difficult.

The scientific method also requires that the negative cases be taken into account. For example, it is commonly believed that blondes differ from brunettes in certain personality traits. If you start with this hypothesis and observe all the blondes and brunettes you know, you might conclude that blondes are domineering and brunettes are submissive. You have failed in this case, however, to note the exceptions to your hypothesis, namely, the characteristics of the brunettes. When all the cases have been observed and recorded for a large group, it is found that the blondes possess the brunette traits and the brunettes the blonde traits as frequently as they possess the traits ascribed to each type exclusively.

In another instance, a friend who was studying the violin in Paris related that one day he felt a tug at his coat; and when he turned around, he saw an image of his mother. A few hours later, he received a cablegram stating that his mother had died at the time she had appeared to him. "How do you account for that?" is the oft-repeated question. Before one drew any conclusions, one would want to know how many times previously he had seen an image of his mother *without* getting a cablegram. Dreams sometimes come true, and those that do not are forgotten. Dogs often howl just before a death in the family, but they howl at other times too. The reason they do not sound so mournful to you then is because of your own unawareness at the time. While it is sometimes possible in a natural situation like this to isolate all of the important factors and to evaluate their effect on the phenomenon in question, it is frequently expedient to arrange the situation in such a way that we can control all the variables to be observed.

The importance of controlling the variables is nicely illustrated by a little investigation of a certain "rod diviner's"

ability to locate water, oil, or minerals under the surface of the ground.[1] For many years, this man had established a reputation for locating oil or mineral deposits by carrying a rod or forked stick over the territory to be explored. Numerous authentic testimonials bore out his claims. When he came to the laboratory, it was for the purpose of learning the basis of his mysterious powers.

In preparation for the test, gold watches and other metallic articles were placed under a large table, marked off in sections. The subject, blindfolded, was to locate, with his divining rod, the section under which the articles had been placed. In another experiment, the articles were placed in the room below, and the subject could walk about the floor above. In the third case, he was taken over the campus, still blindfolded, in an attempt to locate the water mains. In each of these tests, he failed to exhibit any significant ability to "divine" the location of the metals or water. Sometimes a student objects that the situation is artificial and that the quantity of metal or water is too small to be effective in influencing the diviner. Artificiality is the objection to laboratory experiments commonly given by those who do not understand the significance of experimental procedures. However, if the principles involved in a scientific experiment are considered, it will be recognized that in this instance the conditions were adequately controlled. All the conditions were constant throughout the experiment. The only variable was the position of the metal that was to be located. Instead of ore deep in the ground, pure metal was used, with only a table top intervening. This should have made the task easier if no other cues, such as rocks, contour of the land, and so forth, were not taken into consideration by the diviner. The same principles were involved in locating the water mains.

A geologist uses his knowledge of contour of the surface, rock and soil formations, and so forth as guides in "guessing" the best location for a well or mine. Could it not be that this "rod diviner" had acquired some geological knowledge and utilized

[1] Foster, W. S., "Experiments on Rod Divining," in *Journal of Applied Psychology* (1923), Vol. VII, pp. 303–311.

it in his work, in spite of his faith in his divining rod? It would have been interesting to have carried the experiment further and to have investigated his divining ability in the oil fields without his divining rod, although this arrangement would present another variable that would need to be controlled. The absence of his rod might distract his attention and thus upset the observations upon which he depended, just as in the case of the youngster who cannot recite when the teacher instructs him to "stand on both feet" or to take his hands out of his pockets.

THE EXPERIMENT PROVIDES A MEANS OF INVESTIGATING ONE VARIABLE AT A TIME. All other variables or influences are either held constant or eliminated. This method presents pitfalls, however, against which one must carefully guard. The laboratory is an artificial setting created for a specific purpose. When each variable has been investigated, the interpretation must be based upon all the data assembled. If one or more important variables have been neglected, our conclusion may prove inadequate when we take it outside the laboratory. This consideration the experimenter must always take into account.

The experiment. The rules of the scientific method are embodied in the conduct of an experiment. This means that the term "experiment" has a rather precise meaning. In our everyday conversation, we use the term rather loosely. We "experiment" in bridge, love-making, and business methods. To be scientific, however, the experiment must adhere rather closely to prescribed procedures. The various steps in the experiment usually occur in the following order, although the sequence is not so important as the steps themselves:

1. First, some working hypothesis is stated. We have learned that the hypothesis is simply a guess. The guess is usually based upon past experience; it is stated in such a way that it fits the facts available. Not all hypotheses have been arrived at in this way; nor is it necessary that they should be. Some of the hypotheses that have served as the basis for historically important experiments have developed quite by chance. An accident in a chemical laboratory, for instance,

or a chance observation in a biology laboratory, or a casual experience by a person engaged in some routine daily activity may serve as the basis for an experimental test. "I wonder if this is always true," the scientist may say to himself as he sets out to put the hypothesis to a test. Or: "Could it be that this fact will account for other happenings that I haven't been able to explain?" Sometimes the hypothesis has come from a dream of a person who has been concerned about some problem and has gone right on "thinking" about it in his sleep. The hypothesis is important because it gives direction to the experiment. It determines what observations will have to be made; it is a necessary first step.

2. After the hypothesis has been stated, steps are taken to exercise rigorous controls over all variables affecting the observations to be made. Often, these variables are legion. In some instances, all the variables may be known to the observer; in others, there may be no way of determining which variables operate to produce the effects to be observed. The latter situation is especially true in scientific psychology because of the enormous complexity of the problems involved. (In many of the experiments in physics, chemistry, and physiology, on the other hand, the situation is simplified, because in these sciences it is generally easier to isolate the factors that are important to the events to be observed.)

So it happens in psychological experimentation that every conceivable variable must be accounted for simply because we seldom know just which variables may be producing or affecting the behavior we are examining. Suppose, for instance, that we wished to test the hypothesis that women are more intelligent than men. That statement has been made by respected authorities and has sometimes been used to account for the fact that women get somewhat higher grades in college than do men. It is a good guess. But try to imagine all of the variables that must be taken into account in the testing of such a hypothesis! First, we would have to agree on some measure of intelligence. Then, if we were to compare a group of men with a group of women, we would have to pay careful attention to age, representativeness of men and women in general, heredi-

tary background, socioeconomic status of their families, schooling, type of community (rural or urban) in which they were raised, their motivation at the time we make our measurements, and many other factors of equal or greater importance.

The scientist is sometimes helped in his attempt to control or account for all of the variables by the use of apparatus. Other uses for apparatus lie in the assistance it gives in the actual making and recording of observations. As a matter of fact, unless apparatus serves one or both of these functions, it can be considered superfluous. This point is made here because of the tendency on the part of many people to judge the scientific worth of an experiment in terms of the amount of complicated apparatus that is used. Scientific observations may be made with no more apparatus than a sharp pencil and a piece of paper. On the other hand, some of the more popular quack psychologists use a very impressive array of complicated but useless machinery. A very successful phrenologist, for instance, employs a device that looks like a cross between a permanent-wave machine and a printing press.

Many an experiment has bogged down at this stage because of either intentional or unintentional disregard of important factors. Suppose, for instance, in comparing the intelligence of men and women, the investigator failed to take into account the matter of motivation of those being tested. If the men were more highly motivated, the difference in performance would be a matter, not of intelligence, but of motivation. Suppose the experimenter neglected to take into account the factor of schooling and training. It is known that the training of girls is inclined more toward verbal than toward mechanical skills. If the measurement of intelligence used employs a great amount of language, we would expect women to do somewhat better because of their background. Here, obviously, it would be possible for two experiments to come to directly contradictory conclusions, since each one had neglected an important variable.

3. The actual collection of the data would be the next step. The reason why this step deserves mention here is that the collection of the data is so easily affected by the bias of the in-

vestigator. It has been said that the least accurate piece of equipment in the scientific laboratory is the investigator himself. One reason why this is true is that bias and prejudice regarding the outcome of the experiment can figuratively close the eyes and ears of the experimenter, so that he fails to see or hear and record important events that are taking place. This is why the recording function of apparatus is so valuable. The net result of this failure to observe everything that happens during the experiment is that negative instances are disregarded.

By *negative instances,* we mean those things that happen which are not in accord with our original hypothesis. If we were to put our finger on the one important difference between an experiment conducted along scientific lines and the observations that most of us make in our everyday contacts with other people, it would be this tendency on our part to disregard or to forget those instances that do not fit in or agree with our pet hypotheses. We do this every day of our lives. Sometimes we are aware of some discrepancy between what we believe and what we see or hear, but usually we promptly forget the inconsistency. At other times, we are not even aware that the discrepancy exists, because our own limited experience does not bring us into contact with situations in which our hypothesis is not true. A little later we shall see that the so-called *type fallacy* is due to this very fact. There is no such thing as the "intellectual type" or the "feminine type." In order to believe in and speak in terms of such types, we must either not know about or simply disregard those people who do not fit into the molds which those types imply. IT IS VERY IMPORTANT, THEREFORE, THAT THE SCIENTIFIC OBSERVER GIVE FULL WEIGHT TO ALL NEGATIVE INSTANCES AND THAT, WHEREVER POSSIBLE, HE USE APPARATUS TO RECORD THE EVENTS OF THE EXPERIMENT.

4. A word about the statistical treatment of data: There are two things to remember when you think about mathematics and statistics: (*a*) you can prove almost anything you want to prove if you use the "right" mathematics; and (*b*) no amount of statistical number work will make inaccurate observations

accurate. As we shall see later, it is convenient to perform certain statistical manipulations with data in order to make them somewhat more manageable and to bring out relationships not immediately apparent from the data themselves. However, it is always important to remember that, when we begin to add figures, or to subtract or divide or multiply, we make assumptions about those figures that may not be even remotely true. Under these conditions, the result of our "mathematical" treatment of the data will be confusion or falsehood. This warning is intended simply to put you on your guard.

Mathematical is not even distantly synonymous with *scientific.* Suppose, for example, someone were to stand in the schoolyard during recess and estimate the intelligence, or I.Q., of the fifth-graders who were playing there. To get an average, we could take these estimates, add them up, and divide by the number of children. Suppose we say the average I.Q. turned out to be 96.8874. This number is obviously useless, because although it creates the illusion of accuracy with all those figures after the decimal point, the original observations were so grossly inaccurate that we should probably have paid no attention to them in the first place. As another illustration, we might copy down the numbers on the doors of all the rooms on the floor on which your class is meeting. Now, if we add these numbers and divide the sum by the number of rooms, we would come out with what: "the average room number?" "the number of the average room?" Obviously, all this mathematics is nonsense, because the numbers were not addable to begin with. Do not get the impression, however, that all statistical treatment of data is a waste of time. Far from it; a great deal of data would be entirely meaningless to us unless there were certain ways of handling them so that they could be more easily manipulated, talked about, and compared with other data.

5. The last step in the scientific procedure consists in the formulation of laws or generalizations that follow from the data collected. Sometimes this step amounts to nothing more than a statement that the original hypothesis is either true or not true. One must be particularly careful that these

statements about the hypothesis, these laws or generalizations, be confined to the data collected. The tendency is to go beyond these data and to maintain that the law will hold under other conditions as well as those under which the data were collected. To revert to our example, suppose our data were to show that women are more intelligent than men. We may say that our hypothesis has been verified. It thus becomes a fact that women are more intelligent than men. In our enthusiasm over the results of our experiment, however, we might be tempted to go beyond our data and say that women would make better grades in college than men. Our experiment yields no evidence on this point. The latter statement is neither a law nor a fact based upon our data, but it does become another working hypothesis. It becomes the starting point for another series of observations. This tendency to generalize beyond the data is a very common one. Scientists do it, and all of us do it as the result of our own experiences. There is no harm in such a practice unless we fail to realize that we are again talking in terms of hypothesis —not law or fact.

Study this chapter carefully. It contains many points that will serve as the "theme song" for the rest of the book. If you understand them and put them into use as you go along, you will have less trouble in seeing your way through. It will be easier for you to discard some of your pet beliefs and to assimilate new material.

2

The Organism and Its Environment

PSYCHOLOGY MAY BE DEFINED AS THAT BRANCH OF SCIENCE WHICH STUDIES THE BEHAVIOR OF AN ORGANISM IN ITS ENVIRONMENT. To be sure, we are primarily interested in the behavior of the organism *man*. A glance at Figure 1 will indicate that, in the series from the lowest forms of animal life, there is no distinct cleavage between man and the lower animals. This fact does not belittle man, for we find him at the top of the scale. Nor is it proposed that man is on a level with the monkeys and apes, as our chart seems to indicate. The chart merely shows the relative position in the scale according to structural similarities and differences. What is indicated is not that man is a descendant of the monkey, but that man, like the other forms of life, has had a long past.

Man, like other organisms, ingests food, grows, and reproduces his kind. He also, like other organisms, is affected by changes in his physical environment. These four characteristics—assimilation, growth, reproduction, and irritability—characterize and relate all living organisms. We start, then, with the recognition that man belongs to the animal kingdom, even though somehow he is superior to all animals. This superiority must reside in the structure of the human organism. Let us examine some of the gross anatomical structures that may play an important part in this superiority.

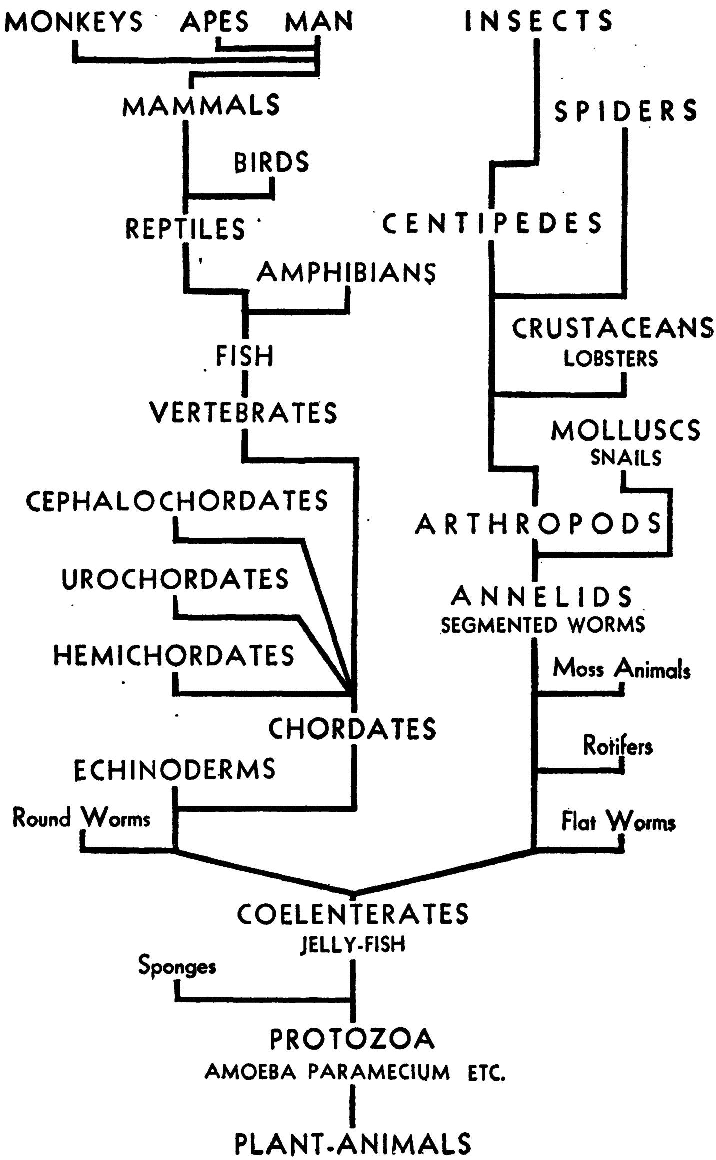

FIGURE 1.—A FAMILY TREE OF THE ANIMAL KINGDOM, GREATLY SIMPLIFIED.

Structural Differences

Hands

If you will look at one of your hands, move the fingers and thumb into all the positions possible, and then think of all the things you can do with that hand—such as use a hammer, pick up your pen and write a letter—you will begin to realize how

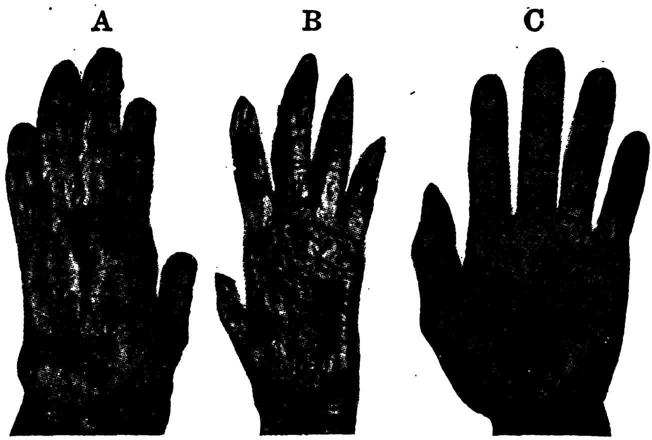

FIGURE 2.—HANDS OF TWO CHIMPANZEES AND AN ADULT HUMAN BEING. *A,* juvenile male chimpanzee; *B,* adult female chimpanzee; *C,* adult male. (From Schultze, "Man as a Primate," in *Science Monthly.*)

vastly important this one structure is. No machine has ever been invented that can do as many things as an ordinary human hand can do. No other animal possesses a hand that is so facile in such a variety of movements. These manipulations are greatly augmented by the position of the thumb in apposition to the fingers. The hand of the chimpanzee (Figure 2) resembles the human hand, but the fingers lack the flexibility of human fingers, and the thumb is not important. Apes and monkeys may possess greater strength. Some of them—such as the gibbon—can swing through the trees hand over hand, fifteen to twenty feet at each swing, but this is almost the limit of their prehensile ability. They do a poor job of throwing sticks from the tree when disturbed

by human observers. They can pick up and examine objects, and can learn to use tools in a primitive fashion, but they can never approach human skill of manipulation.[1]

Upright posture

Another advantage of man is that he can stand erect. Many animals can stand on their hind legs (Figure 3), but the posture is too difficult to be of much service. The attachment of the head and neck muscles in man, as well as the skeletal forms of the hip and leg joints, makes the upright posture natural to man, thus freeing the hands and arms for activities other than locomotion. It would be interesting to speculate as to what might have been the course of civilization if man had possessed no better facilities for manipulating objects than those the ape has. Just as interesting is our own dependence upon our hands in learning about our world. As a child, we have handled objects as a means of becoming acquainted with them.

Speech mechanisms

Just as the more facile hand augments the variability of behavior, so do the more highly developed speech mechanisms for vocal response increase this possibility. The development of language is one of the great accomplishments of man. No other animal can make the great variety of sounds that man can make. Many animals communicate with one another vocally, but they are limited to a small repertoire of calls, principally as warnings of danger. Birds seem to possess the greatest range; but here again the differentiation of sounds is largely a matter of high and low tones, with no sounds that can be identified with the consonants and vowels of human speech. There are exceptions, such as the parrot, which may learn to produce many human speech sounds.

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[1] Valentine, W. L., *A Genetic Study of Manipulation,* a moving-picture film prepared at Ohio State University. Heinrich Klüver has made a motion-picture film of a cebus monkey getting food that is out of reach. Although he is able to rake in the food, his movements are poorly co-ordinated.

FIGURE 3.—THE FEMALE CHIMPANZEE OF THE ANATOMY DEPARTMENT OF JOHNS HOPKINS UNIVERSITY. (From Schultze, "Man as a Primate," in *Science Monthly.*)

These sounds, however, when closely observed, are poor replicas of human speech.

In a later chapter, we will have occasion to examine the role played by the speech mechanisms more closely. We shall see that a great deal of what we call *thinking* is done with the speech mechanism. Ask a friend to add 412 to 356 "in his head," and then watch his lips and throat very closely. Try this with several different problems in addition, and you will see that the problem is solved by a great deal of talking to oneself. Sometimes the talking may become loud enough so that you can hear your friend mumble slightly as the entire speech mechanism is thrown into operation by the presentation of the problem. The effect of this talking to oneself is to speed up the thinking process enormously.

Suppose, instead, that the problem had to be done by actual manual counting. Even simple problems would appear complicated if solved in this way. Man uses his speech, then, as a short cut for other forms of behavior. In addition to this use, there is, of course, the employment of speech as a signaling device. This use is somewhat similar to that made by the lower animals. Man's communications are, however, complicated in a way that no other animal can approach. Thus man can utter commands that contain specific directions. He can express wishes, desires, ambitions. He can administer praise and blame, and in a host of other ways can influence the behavior of his neighbors through the use of the speech mechanism alone.

Neural structure

Of course, only part of the story of the superiority of man over the lower forms of animal life is told by listing the structures we have just considered. No matter how well developed these structures might be, they would be relatively ineffective were it not for the complicated labyrinth of nerves that connects them with one another and with all parts of the body in an almost inconceivably complex pattern of response possibilities. Some neurologists have described this aspect of man's superiority in terms of *neural overgrowth.*

Neural overgrowth consists chiefly of that part of the nervous system which is in excess of the amount necessary for carrying on the purely vegetative functions—eating, reproduction, reflex movement, and so forth. Most of this excess is found in the brain and spinal cord—the central nervous system. Even a casual observation of this part of the nervous system in man will reveal the possibilities for complication it affords. Those neurologists who have attempted to describe its complexity have ended up with such astronomical figures that we simply cannot comprehend the degree of involvement which they imply. One neurologist estimates that the outer layer alone of the brain contains about 12,000,000,000 separate neurones. If only 1,000,000 of these neurones were connected in pairs, in every possible combination, the number of combinations possible would be represented by 10 with 2,783,000 zeros after it! Of course, in the nervous system, these neurones are connected, not only in pairs, but in threes and fours, and in many other intricate combinations.

Before we go any further, it might be well for us to pause for a moment and be sure that we fully realize the importance of the points made so far in this chapter. It requires only the most casual examination of the behavior of man and the lower animals to see that there is a vast difference in the complexity of the performances of which each is capable. This difference has always puzzled those who have taken the time to think about it. The explanations for the difference are almost as many as the number of people who have tried to explain it. One very convenient way to account for the difference is to say that, structurally, man and the lower animals may be alike, but that man, in addition, possesses a mind that makes it possible for him to do such vastly superior things. Others have said that this "something extra" which man possesses is a soul, or self, or spirit, or ego, or conscience, which the lower forms do not possess, and that the differences in behavior are directly traceable to this fact.

This brings us to an important step you will take in your study of human behavior. It is simply this: IN DESCRIB-

ING BEHAVIOR, YOU MUST FIRST EXHAUST ALL OF THE POSSIBILITIES THAT MAN'S STRUCTURE AFFORDS. You must not have recourse to mystical, psychical, spiritual, or other vague concepts until it has been established that description in terms of structure is inadequate. This means that, for the time being at least, you will have no need for such terms as "mind," "conscious," "subconscious," and others like them. To avoid the use of the term "mind" is not to deny that there is a mind. We are simply going to try to describe behavior without using the term at all. If we fail, it may be necessary to come back to some such explanation later. The chief advantage to be attained in asking you to do this is that descriptions will be more meaningful if we all mean the same thing by the terms we use.

You may see the disadvantage in naming rather than attempting to describe events if you ask five of your friends to write down on a piece of paper their definition of the word "mind." Ask them to give you a clear-cut statement in the form of a sentence. If you try this, you will discover two things: (1) it will be hard to find two statements that are exactly the same or even nearly the same; and (2) some whom you ask will not be able to give you any kind of a statement at all. Perhaps this point should have been made in the previous chapter, although this is the first time we have encountered it, but a scientist must always define his terms. NO SCIENTIFIC DESCRIPTION IS POSSIBLE UNLESS ALL OF THE TERMS IN THE DESCRIPTION HAVE BEEN RIGOROUSLY DEFINED.

If it is agreed that we will try to phrase our descriptions in terms of structures and their functions, it now becomes necessary for us to devote some attention to those structures that we find cropping up most frequently in our descriptions. It will not be necessary for us to go into minute detail. To do this would require time out for whole courses in human anatomy, neurology, and physiology. Besides, in this day of enlightenment, most of us already know a great deal about the structure and workings of many parts of our body. We need only to fill in a few gaps and to straighten out a few misconceptions.

Receptor Mechanisms

A necessary first step in every response that an individual makes is the stimulation of one of his sense organs. We have used some terms here that need defining. A *stimulus* is any physical change that acts upon a receptor. A *receptor,* or *sense organ,* is a specialized part of the body sensitive to certain changes in its environment and not to others.

What we have said in effect is that EVERY RESPONSE IS PRECEDED BY A STIMULUS. We must overcome the notion that behavior just happens, or that it can be spontaneous or without any cause at all. Of course, it is not always easy to locate the particular stimulus that precedes certain responses. A man is seen leaving his house in the morning on the way to his office. Suddenly, in the middle of the block, he wheels around and starts back toward his house. What was the stimulus here? No one called to him or sprang at him from the bushes. It would certainly seem that this behavior was spontaneous. As a matter of fact, some of us would describe this situation by saying simply that the man changed his mind, or that he suddenly remembered something he had left at home. Neither of these statements, however, would tell us what the stimulus was. Perhaps, if we had been walking beside this man as he left his house, we might have noticed that he was mumbling to himself, frowning, and obviously thinking about something—maybe planning the day's work at the office. As we shall see later, this matter of talking to oneself can and does constitute an important source of self-stimulation and produces some rather marked effects on behavior. Perhaps this, then, was the stimulus that preceded the sudden change in the direction of the man's walking. The principle states, however, that we may be sure that there was some stimulus, even though it was not immediately apparent.

The converse of this principle is also true: EVERY STIMULUS IS FOLLOWED BY A RESPONSE. Here, again, it is not always easy to find out just what the response is. Sometimes the indi-

vidual appears to do nothing, and sometimes an additional stimulus produces no observable change in behavior that is already taking place. At other times the response seems to be greatly delayed. Suppose you ask a friend to call you at eight o'clock in the evening. Your friend may not even acknowledge the request. You may have no way of knowing whether the stimulus of your voice produced any response until, finally and promptly at the appointed time, your telephone rings, and you receive the requested call. Our principle states that there was some response to your voice at the time you made the request. Apparently, the effects of this response were carried over, so that behavior at a later time was also influenced. We will have occasion to discuss this phenomenon at greater length a little later on.

Before we turn to a more detailed examination of the sense organs themselves, there is one more misconception that will have to be corrected. It is conventional to think of man as having five senses—seeing, hearing, tasting, smelling, and feeling. Sometimes we talk rather vaguely about a "sixth sense" said to be possessed by those who are especially clever in outguessing other people or in anticipating the outcome of certain events—such as horse races, stock-market changes, business ventures, and the like. As we shall see, man has many more than five senses, and if we are to talk about an "extra" sense, we will have to number it much higher than "sixth" in order to be beyond the range of those already known.

Seeing

Light waves, commonly described as *ether vibrations,* enter the eye through the *pupil,* pass through the *lens,* and are focused in the *retina* (Figures 4 and 5).

The retina is the true receptor of vusual stimuli. Its principal elements are minute structures called *rods* and *cones.* The rods enable us to make only colorless discriminations. They also require less light than do the cones. Thus, at night, when the intensity of light is reduced, objects may be seen, but their color cannot be discriminated. At night, all cats appear gray. The cones respond differentially to wave

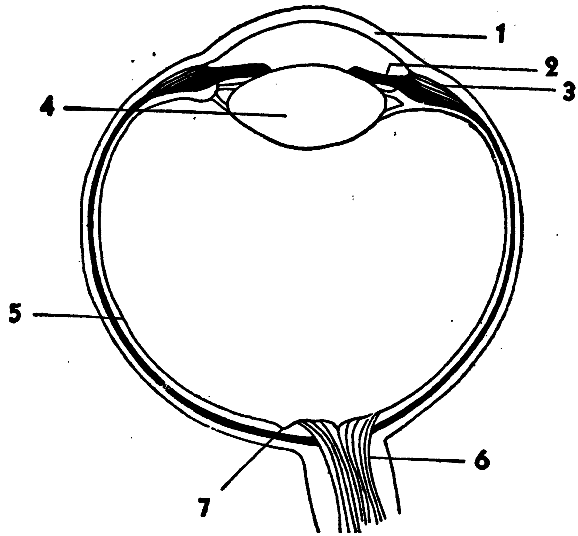

FIGURE 4.—DIAGRAM OF CROSS-SECTION OF THE HUMAN EYE. 1, cornea; 2, iris; 3, ciliary body; 4, lens; 5, retina; 6, optic nerve; 7, fovea.

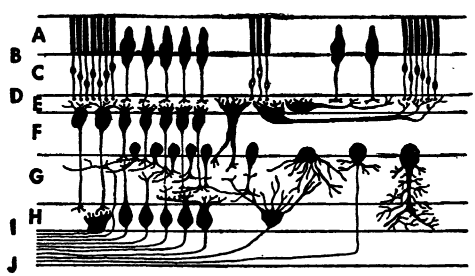

FIGURE 5.—DIAGRAM OF THE PRINCIPAL STRUCTURES OF THE RETINA. *A,* layer of rods and cones; *E,* outer synaptic layer; *G,* inner synaptic layer; *H,* ganglion cell layer; *I,* axone layer.

lengths beginning with red at about 760 mμ [2] continuing through the spectrum, orange, yellow, green, blue, and violet, to about 390 mμ. These colors are visible only when the person is looking fairly directly at the source of light. The periphery, or boundary, of the retina is practically color-blind.

Another characteristic of the retina should be stressed,

[2] mμ = .00001 millimeter.

although it has nothing to do with color vision as such. The cones are more closely packed together in a small, central area of the retina, which increases the visual acuity, or distinctness of vision, at this point. If you will place a dot in the middle of this page, then cover one eye, and fixate the point with the other, you will observe that you are able to read only a few letters on either side of the point. This characteristic is an important feature of the eye, because it not only provides an area of increased acuity, but it also necessitates eye movement. This is one of the reaction mechanisms that might have been described in the first part of the present chapter.

Reference to Figure 6 will indicate how narrow a band of the total spectrum is visible. Some of this band we receive as heat (infrared), but the greater part is known only indirectly. By means of specifically prepared photographic plates, some of these waves—such as the ultraviolet and X rays—are indirectly known, although we have no receptors that respond to them. It is not always necessary to see or to touch a thing to know that it exists. We may use instruments to detect some of its characteristics.

The totally blind. Sometimes the role of these sense departments is best illustrated by abnormal cases. Although the partially color-blind do not appear to be greatly inconvenienced, we often fail to realize the seriousness of the handicaps of the person born blind. We know that blindness is a handicap because we can see that it is inconvenient for the blind to get around, to read, and to do many things without assistance which the seeing person does. We also sympathize with him because he misses, as we believe, so many beautiful things that we get through sight. We think of the difficulty and danger in crossing the street; of his inability to read the paper, or to see his children or the attractive landscape.

There are, however, more serious losses for the one born blind. Even the one blinded later in life is more fortunate in many respects. Consider how the normal child learns about his world. He not only hears and touches objects but he

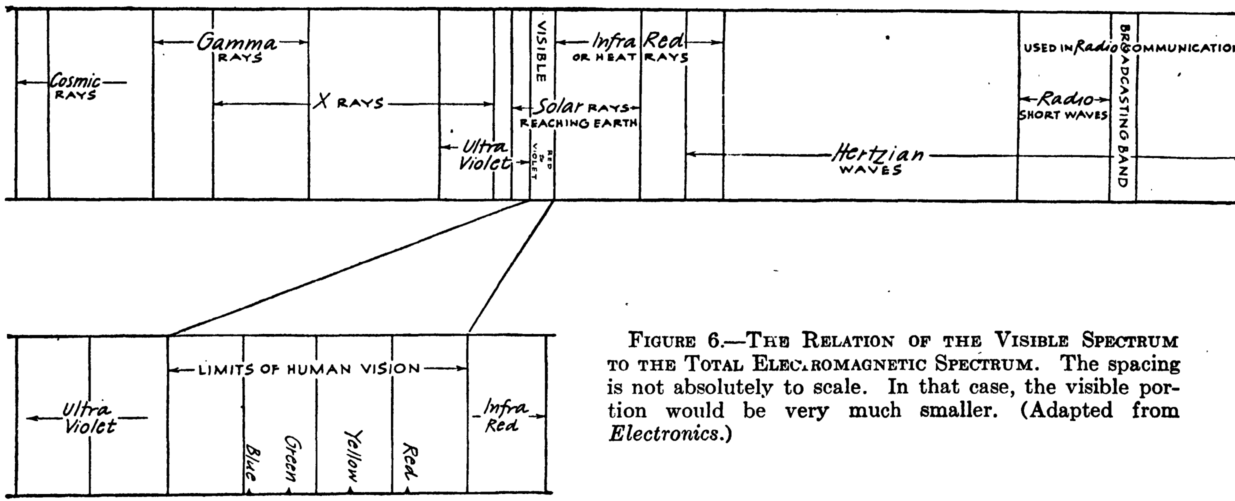

FIGURE 6.—THE RELATION OF THE VISIBLE SPECTRUM TO THE TOTAL ELECTROMAGNETIC SPECTRUM. The spacing is not absolutely to scale. In that case, the visible portion would be very much smaller. (Adapted from *Electronics*.)

sees them, and he sees what other people do. He learns to reach for objects and to imitate others in handling them. When his mother reads him a story, he sees what she is doing. The child born blind may touch and handle objects and may hear his associates talk about them, but his opportunity to learn to deal with these things and to acquire language rich in meaning is greatly limited. Consequently, unless given special training, he will live in a world of rather narrow social interests.

Consider an extreme case—that of a young man, born blind, who, at the age of twenty-four, entered a school for the blind. He came from a good middle-class home, where he had been properly cared for but with apparently little thought for his need of special training. He presented a picture of a deformed, apelike individual. He would not enter into the conversation but would stand outside the group, making a peculiar clicking sound in his throat. He was never embarrassed when he belched in public, and showed little emotion in any social situation. He expressed no loneliness at being away from home; and on one occasion, when he was held up by two thugs, he showed no fear because, as he explained, he had no money for them to rob him of. He could play on the piano numerous selections that he had heard on the radio, although he knew the names of only a few of them. The others were "just hymns or something." It is quite probable that this man was not feeble-minded. He learned some things quickly, although he was extraordinarily inept at others. It seems that his environment had been so limited through lack of vision that he simply had not learned what others learn as a matter of course.[3]

Not all totally blind persons are so subnormal as this young man. When they have been given special opportunities, they are able to overcome their handicaps. Take, for instance, the case of a blind girl whose mother made a thorough study of the problem and afforded her child every opportunity

[3] Cutsforth, Thomas D., *The Blind in School and Society* (New York, D. Appleton-Century Company, 1933).

for a normal development. When this girl graduated from college, she traveled alone to an Eastern city for further study. On the train, she made the acquaintance of other college girls on their way to the same city. She continued her friendships with these girls, going to parties with them, and displaying the same social interests.

Hearing

Another highly specialized receptor is the mechanism of the ear (Figures 7 and 8). It is stimulated by vibrations, or alternate condensations and rarefactions in the air. These pressure variations act upon the *eardrum,* or *tympanum,* which activates three small bones, or levers, which in turn pass the vibrations on to the *cochlea* of the inner ear. Here the vibrations stimulate hair cells lying on the *basilar membrane.* Low frequencies stimulate hair cells at the small end of the cochlea and produce low tones, while high frequencies stimulate hair cells at the large end and produce high tones.

Again, all physical changes of this sort are not stimuli in the sense that the ear responds to them. Ordinarily, the human ear is not responsive to frequencies below 20 per second or above 22,000 per second. Some animals respond to frequencies that are not audible to human ears. Sir Francis Galton, who at one time was interested in the hearing of animals, attached a rubber bulb to the end of his cane and connected the bulb to a small whistle. The frequency of vibration could be varied. As he went about the zoo, he would press his cane on the ground and thus activate the whistle without otherwise attracting the attention of the animals. He found that many animals responded to tones that were too high for him or for his friends to hear. Today, a modified Galton whistle is often used for calling dogs. A dog will learn to respond to a tone too high for your neighbors to hear as readily as he will to your shouting.

As we grow older, our upper limit of hearing becomes more restricted. A person of 50 or 60 may not be able to hear above 15,000 vibrations per second under conditions in which

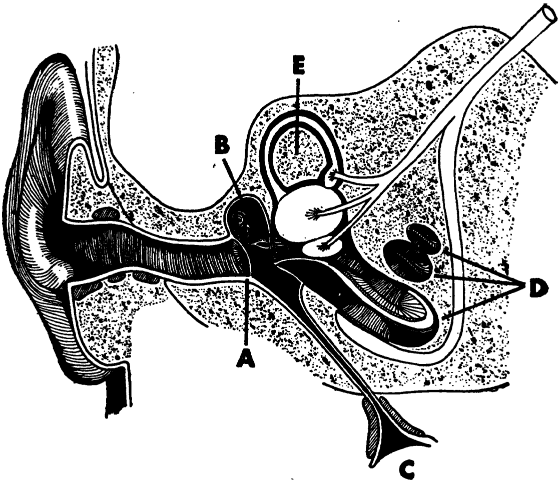

Figure 7.—Cross-section of the Skull Showing the Relationship of the Middle Ear, Cochlea, and Semicircular Canals. *A,* tympanic membrane; *B,* middle ear; *C,* Eustachian tube connecting middle ear and pharynx; *D,* cochlea; *E,* semicircular canals. (From Hough and Sedgwick, *Human Mechanism,* Ginn and Company.)

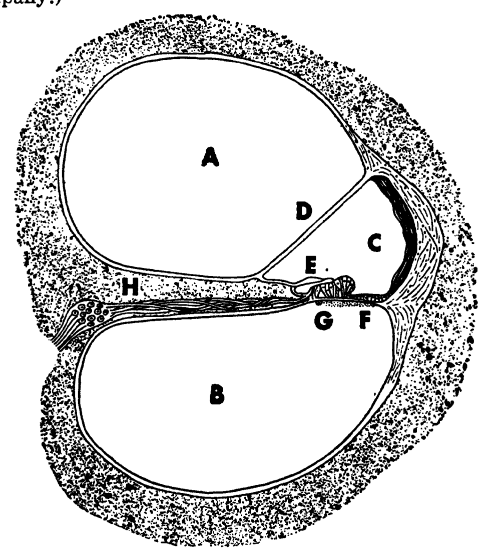

Figure 8.—Transverse Section of the Cochlea Showing the Basilar Membrane, the Rods of Corti, and the Sensitive Hair Cells. *A,* scala vestibuli; *B,* scala tympani; *C,* cochlear canal; *G* and *F,* basilar membrane on which are the rods of Corti and hair cells; *E,* tectorial membrane; *H,* spiral ganglion containing the cell bodies of the neurones that make up the auditory nerve. (Modified after Foster.)

the average student has no difficulty in hearing much higher tones. Often, the hard-of-hearing have difficulty in understanding speech, or cannot enjoy music because they cannot hear tones of certain frequencies.

The totally deaf. Just as in the case of the blind, the door to a large part of the world is closed to the deaf. Here it is also true that the congenitally deaf person suffers a greater handicap than the one who loses his hearing in adult life. The principal handicap of the congenitally deaf is the lack of any verbal language. Usually, at school age, he does not even know that he has a name. Furthermore, the social atmosphere in which he lives, even in the early months of life, is different from that in which the hearing person makes adjustments to the world. The hearing infant is affected by the tone of the voice long before he can understand what is being said. The deaf child apprehends only that to which he gives visual attention.

Touch, temperature, and pain

We usually think of the skin as a uniform layer or covering that not only protects the body but serves as a single organ of "feeling." Actually, it can be demonstrated that there are numerous receptors scattered through the skin which respond in different ways. Thus, if you press lightly upon the skin of another's arm, he will report that he feels the pressure at some points and not at others. *Touch spots* are distributed irregularly through the skin. More startling is the discovery that *pain spots* exist. They are more numerous than touch spots and require a more intense stimulus.

If you are exposed to the rays of the sun or a warm radiator, your skin feels warm all over the exposed areas. Here, again, exploration with a warm point reveals that *warm spots* exist and that intervening areas are insensitive. *Cold spots* are also in evidence when the skin is losing heat. As these four kinds of spots occur separately, we might conclude that there are at least four types of receptors in the skin; or that stimuli produce four specific conditions in the skin that activate correspondingly different nervous impulses.

Muscular movement

As you move your arm or fingers with eyes closed, you can locate quite accurately the extent of the movement. We term these discriminations of movement *kinesthesis*. Experiments have shown that there are receptors in the muscles and tendons themselves, which are stimulated by the pressure of muscle contraction and in the joints as their surfaces rub against each other.

We are inclined to emphasize the importance of the eye and to overlook the fact that so much depends upon the receptors of the skin and muscles. The mechanisms of response, manipulation, speech, eye movement, and ability to stand or walk all depend upon the stimulation of the proper receptors for their guidance. Try to imagine an individual with no functioning receptors in the skin or muscles. He would be in a worse predicament than the totally blind. We learn about our world by dealing with it and moving in it, not by merely seeing it or hearing it.

Equilibrium

In the ear, there are special mechanisms not related to hearing that function in movement and posture (Figure 7). Every youngster has discovered that, if he whirls around a few times, the room seems to whirl when he stops. The *semicircular canals* of the inner ear have been excessively stimulated. This sensitivity has become an important item in the tests of airplane pilots. Although the semicircular canals, together with two other allied receptor mechanisms, the *saccule* and *utricle,* furnish cues to our position and movement (whether active or passive movement), we can get along very well without them by depending wholly upon the cues furnished by our eyes, muscles, and skin.

Smell and taste

We confuse our tastes and smells. We say roses "smell" sweet, or something "smells" nauseating. We "taste" the difference in two cakes; the "flavor" is good or bad. Most

of our "tastes" are a combination of taste, smell, temperature, and touch, or the "feel" of the substance. When we have a cold, things do not "taste" right.

Careful experiments in which smell and the other variables are controlled indicate that we "taste" only salt, sweet, sour, and bitter. The receptors for these can be fairly definitely located in the *papillae* of the tongue. Each papilla contains receptors for one or more of these four *gustatory discriminations.*

Our *olfactory discriminations* are not so easily classified. We know that the receptors are in the nose, but they cannot be isolated for individual exploration as can the receptors in the skin or tongue. Nor can they be so definitely separated from the organs of taste. When we inhale an odorous substance, it may not only stimulate the olfactory receptors, but it may stimulate gustatory receptors in the back part of the mouth.

Organic receptors

The environment of the individual consists not only of stimulating conditions outside the body, but it also includes the individual himself. We have seen that his movements are effective stimuli. Internal conditions also affect receptors. Hunger is produced by rhythmic contractions of the stomach when it is empty. The feeling of satiety occurs when the pressure of the full stomach stimulates receptors. Pains, aches, and light pressure sensations in the abdomen originate in similar ways. Thirst, when the fluid content of the body is low, produces a dryness of the mouth which stimulates receptors in the mucous membranes; the same result is observed when excitement stops the flow of saliva. Numerous other conditions can be identified that add to the number of excitations which give the individual knowledge of himself at every moment of his life.

Summary

The list given in Table I just about exhausts the known ways of affecting the human organism through stimulation

from the environment in which it lives. This list could be made a little longer by subdividing some of the sense departments that appear there, but no new ones would be added. This means that there are at least eight sense modalities.

TABLE I

TYPES OF RECEPTORS, THEIR SPECIFIC STIMULI, AND THE RESULTING REACTIONS

Sense Department	*Receptors*	*Stimulus*	*Reactions*
Cutaneous	Skin—corpuscles (?)	Temperature Contact Pressure	Cold, warm, Touch, pain
Gustatory	Mouth—papillae	Solutions	Salt, sweet, sour, bitter
Kinesthetic	Muscle—tendon Muscle spindles, *etc.*	Movement, pressure	Movement, pressure
Olfactory	Nose—epithelial hair cells	Vapors	Unclassified
Organic	Alimentary canal and other tissues	Tissue conditions	Hunger, thirst, pain, *etc.*
Equilibrium	Semicircular canals Muscles, muscle spindles, *etc.*	Movement, muscle tension	Movement, pressure
Auditory	Ear—hair cells of cochlea	Vibrations (20–20,000 per second)	Tones, noises
Visual	Eye—retinal rods and cones	Light rays (760–390 $m\mu$)	Colors, brightness

The only reason we have taken the time to go into the types of receptors here is that it is only through stimulation of one or more of these modalities that the behavior of the organism can be effected. If we restate the converse of the principle again, we should say that any behavior exhibited by the organism must have been preceded by stimulation through at least one of these departments. You will find that this way of thinking about stimulus and receptor will put you on somewhat more solid ground than the more dramatic but less real point

of view indicated by such well-known dicta as: "The eyes are the windows of the soul"; "Obey that still, small voice"; "There are the seven doors to the mind."

Response Mechanisms

Muscles

The statement has been made that every stimulus is followed by some response. Let us now examine the response mechanisms (sometimes called *effectors*) by means of which adjustment to the environment is made. The most obvious responses are made by the contraction of muscles. Most of you know enough about the human body to know what muscles are. It may be news, however, to learn that there are two kinds of muscles: *smooth muscles* and *striped muscles* (Figures 9A and 9B). In general, the striped are larger and stronger, and respond more quickly than the smooth muscles. The striped muscles are involved in the movements of various parts of the body. They move the trunk, the arms, and the legs. The smooth muscles, on the other hand, are concerned chiefly with the vegetative functions of the body. Most of them are located deep inside the body. They are found in the walls of the blood vessels, the intestines and stomach, and in the organs of elimination and reproduction. There are also smooth muscles in the iris of the eye and attached to the base of each tiny hair on the body. Ordinarily, we are not very much concerned about the smooth muscles unless something goes wrong with them, so that our digestion or circulation is upset. They are of interest to the psychologist, however, in connection with certain patterns of response—especially those we call "emotion." We will look at the emotions more closely later.

While we must remember that the muscles respond by contracting, we must also realize that they may respond by relaxing. Even in the normal resting condition, all of the muscles of the body are under slight tension. They may thus either contract or relax when they receive impulses from the nervous system. The physiologist has not yet been able

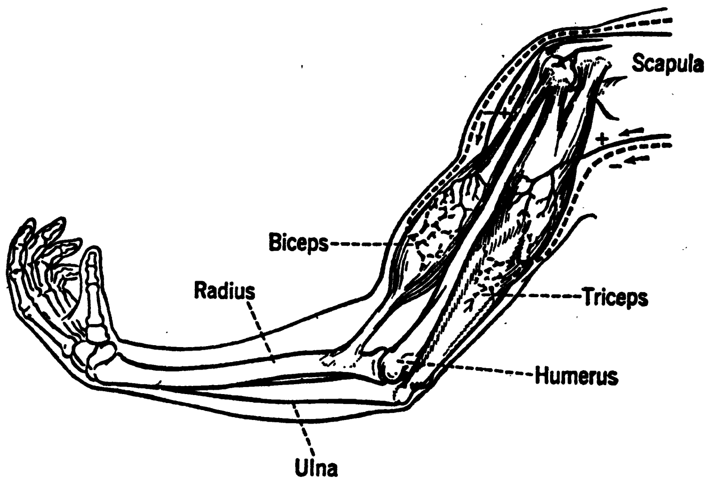

FIGURE 9A.—TYPICAL STRIPED MUSCLES.

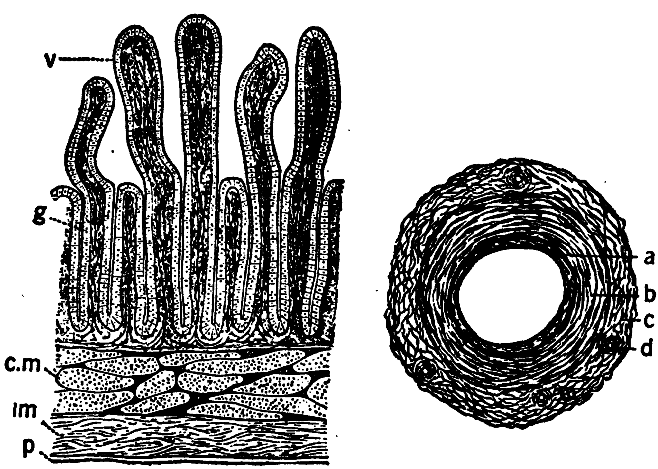

FIGURE 9B.—TYPICAL SMOOTH MUSCLES. The cross-section at the left is a longitudinal section of the small intestine, showing the circular muscles (cm.). On the right is the cross-section of an artery, showing the muscle layer (b).

to tell us just how this action is accomplished, but we need only to observe the behavior of an individual to see that his total pattern of behavior is made up of both contracting and relaxing muscles. You may demonstrate this fact to yourself by raising your hand so that you can touch your shoulder with

your fingers. In order for you to perform this simple movement, it was necessary for the muscles on the top of your arm (the *biceps*) to contract; but it was also necessary for the muscles on the underside of your arm (the *triceps*) to relax. If both biceps and triceps contracted at the same time, they would be pulling against each other; and the chances are that nothing would happen as far as the movement of your arm is concerned. Later, we shall have occasion to see how this simultaneous contraction of antagonistic muscle groups is apparent in certain aspects of learning and even more obvious in emotional disorganizations.

Glands

The activity of the various glands of the body constitutes a very important part of the responses that we make in many situations. It is convenient to divide the glands into two groups: the *duct glands,* which take the secretion of the gland directly to the surface of the body or to the place where the secretion is used; and the *ductless (endocrine) glands,* such as the pituitary gland at the base of the brain or the thyroid gland in the neck. Their secretion is taken up directly by the blood as it passes through the glands into the blood stream. We are not usually aware of the part that the glands play in our everyday adjustments. Occasionally, something happens to bring them to our attention. Someone speaks of food, and our mouth "waters." We do not have to be told that this reaction is simply the increased activity of the salivary glands. Under other conditions, and to other stimuli, these glands respond by a cessation of the flow of saliva. The mouth may become dry, and speaking may be difficult. We have read that, during great excitement, certain of our glands are pouring forth a secretion that somehow or other makes us able to endure long periods of sustained energy output. Sometimes a cold sweat will appear on the face and the palms of the hands. This phenomenon is easily traced to the activity of the sweat glands. These and other evidences in our daily lives can be assembled to illustrate the role played by the glands.

Summary

In this brief section, we have listed all of the possibilities that the human organism possesses of responding to the environment. This fact may be a little hard for you to believe. We are going to try to describe everything a human being can do in terms of the activity in his muscles, his glands, and his nervous system. For the time being, you must try to forget that a man "does" anything with his mind or his will power or his memory. A man not only fights, walks, speaks, writes with his muscles and glands; he also thinks, believes, loves, and learns with them.

Integrating Mechanisms

In the preceding pages, we have described receiving and response mechanisms as though each functioned separately. As a matter of fact, this is never true. Their interrelation has been suggested indirectly several times. For example, we learn about objects in our environment by manipulating them while we are seeing them. This means that receptors of vision, kinesthesis, and touch are co-ordinated with movement. We might also hear, taste, and smell the object. Furthermore, we say the fruit "looks" sweet, the table "looks" hard, a person "looks" honest, or the music "sounds" sweet. In other words, we confuse our terms because we confuse the properties of our receptors. THIS COLLABORATION OF OUR SENSORY AND MOTOR MECHANISMS IS ACCOMPLISHED THROUGH INTEGRATION.

Neurones

THE INTEGRATING MECHANISM IS THE NERVOUS SYSTEM Everyone knows that he has a brain and that it is an important organ, but few realize why or how it is important. Just as the whole organism is made up of a multiplicity of cells, so the nervous system, including the brain, is composed of cells, the *neurones*. Muscle cells contract; other cells secrete fluids; but the chief function of neurones is to transmit impulses. Thus, when a receptor is stimulated, a physico-chemical change is set up in the neurone. This change quickly

passes through the neurone from the point of excitation and, in turn, excites another neurone. This second point of excitation is usually in the spinal cord or brain.

All neurones are alike, functioning in practically the same manner, but they differ widely in shape and size (Figure 10). Some have many branches at the receiving end and few at the effector end, where the nerve impulse is transmitted to the next unit. Some neurones are short, and others possess

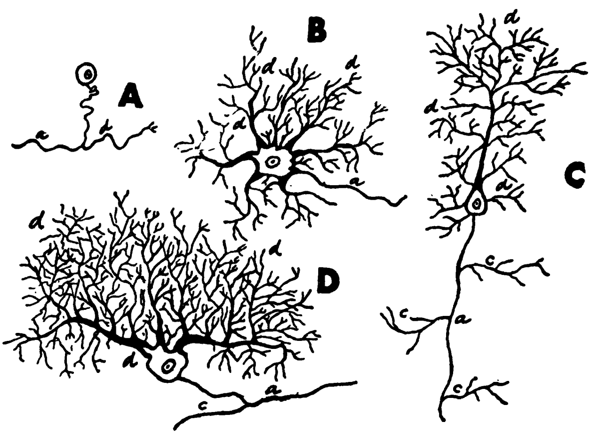

FIGURE 10.—SEVERAL TYPES OF NEURONES SHOWING DIFFERENT SHAPES OF CELLS, AND THEIR BRANCHES. *a*, axone; *c*, collateral; *d*, dendrite.

long branches that may extend from the spinal cord to the muscles of the hand or foot, or from the skin to the cord, and then by another branch of the same neurone to the brain.

The nervous system must not be thought of as a "chain of neurones." Wherever a neurone transmits a nerve impulse to another neurone, it transmits the impulse to many neurones. In the simplest human act, literally millions of neurones are excited. If you tap lightly just below the kneecap, the leg suddenly extends, exhibiting the *knee-jerk reflex*. It is common to describe this reaction as a simple sensory-motor response involving a neurone to the cord and another back to the muscles of the leg. A little observation and thought will reveal to you that this is really a very complex phenomenon. The person may or may not be able to restrain (inhibit) the

response. If, however, he is asked to clench his fists or solve a problem just before the knee tendon is struck, the response will be increased. The simple knee reflex is really complex, for it involves neurones, not only in a direct line from tendon to cord to muscle, but also in the cord and brain. In fact, any part of the cord or brain may influence it.

The cord and brain

A popular misconception is that the brain possesses some unique function or power not related to the rest of the nervous system. We frequently hear the statement that "ideas are stored in the cells of the brain," or the implication that will power or the mind resides in the brain. The brain is not a storehouse. It is a part of the whole action system. THE CHIEF CHARACTERISTIC OF THE BRAIN IS ITS ENORMOUS COMPLEXITY OF NEURAL CONNECTIONS AND THE VARIABILITY OF BEHAVIOR THAT IT MAKES POSSIBLE (page 25).

For example, if you observe a frog whose brain has been removed, you will see that it looks much like a normal frog. But you can predict very well what it will do if you stimulate it. Its behavior is extremely limited. With the brain intact, you still can predict its behavior in general, but not with the precision that you can for the "spinal frog." Greater variability of behavior is manifest in the frog with a brain. Otherwise, the behavior is much the same in both cases. Evidently, the spinal cord allows less variability than the brain.

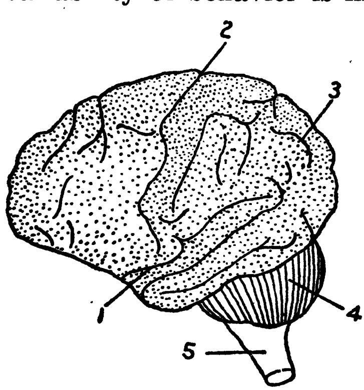

FIGURE 11.

If, now, we examine the brain of a monkey or chimpanzee (Figure 11), we find that it is greatly increased in size in proportion to the spinal cord. If we compare the brain of the monkey with a human brain (Figures 12 and 13), we see that the chief difference is not merely the relative size as a whole, but the increase of the upper portion, the *cerebrum,* in the

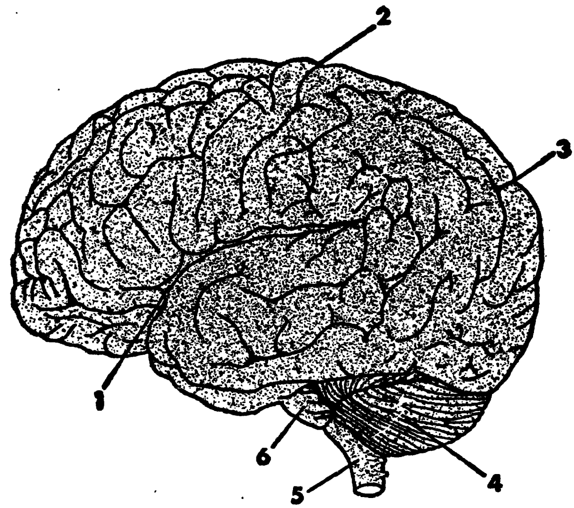

FIGURE 12.—VIEW OF THE LEFT SIDE OF THE ADULT HUMAN BRAIN. 1, fissure of Sylvius; 2, fissure of Rolando; 3, parieto-occipital fissure; 4, cerebellum; 5, spinal cord (medulla spinalis); 6, pons.

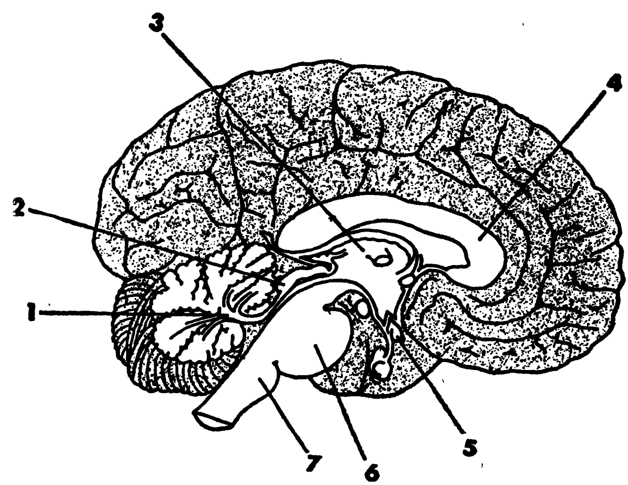

FIGURE 13. VERTICAL MEDIAN SECTION OF THE BRAIN, SHOWING THE LEFT HALF. The cerebrum is the great convoluted mass filling more than half the picture. 1, cerebellum; 2, corpora quadrigemina; 3, thalamus; 4, corpus callosum; 5, optic chiasm; 6, pons; 7, medulla.

human brain. It should be noted that the human cerebrum is not only much larger than the cerebrum of the monkey or ape but that it is also more deeply grooved. These fissures increase the cortical area—a thin layer of interconnecting neurones—and it is the greatly increased complexity of the *cerebral cortex* that is the distinguishing feature of the human nervous system.

The great development of the cerebrum may be looked upon as an "overgrowth," in the sense that we possess more interconnections than we ordinarily need for life processes. Or, to put it in another way, we seldom live up to our possibilities. We could lose a considerable portion of our cortex without showing any effects of the loss in our everyday behavior. This simply means that we are inclined to sink to the level of routine activity. When an emergency arises, or when our environment necessitates a readjustment, we have the neurological equipment to make shifts in our responses.

Conclusions

WE HAVE SEEN THAT THE EQUIPMENT OF MAN INCLUDES RECEPTORS THAT PROVIDE A LIMITED CONTACT WITH HIS ENVIRONMENT. The "windows" of the human organism do not present the total picture of the world. These receptors, however, do give us a variety of aspects of the energy transformations of our world, including those in the organism itself. THE RESPONSE MECHANISMS CO-OPERATE TO MAKE THESE IMPRESSIONS USEFUL. Here man clearly surpasses all other organisms through the possession of hands, vocal organs, eyes that move freely and can function together, as well as through structural features that make a variety of movements possible. BETWEEN THESE RECEPTOR AND RESPONSE MECHANISMS STANDS THE INTEGRATING MECHANISM, THE NERVOUS SYSTEM, CLIMAXED IN THE GREATLY DEVELOPED CEREBRUM. We cannot say that any one of these three factors is more important than either of the others. Without each, there could be no function. It is the co-operative interaction of these three factors that renders man superior to all other animals.

If man possessed hands no more highly specialized than

those of the ape, he could not have acquired his present social status. But he would still be superior to the ape, for the ape, even with human hands or vocal organs, could not have made equal use of them with his brain of greatly simplified cortical integration. This fact emphasizes that what we call "intelligent" human behavior depends upon the functioning of the whole organism, not the brain alone. The whole organism, including its strengths and weaknesses, is responsible for what man has acquired and can still further attain: his civilization, his ideals, his religion, his discoveries of science, his knowledge of the past, and his prediction and control of the future.

3

Heredity and Environment

In the preceding chapter, we placed a great deal of emphasis upon the importance of the structure of the organism as a determiner of the achievement of the individual, and we pointed out in particular that it is because of his structure that man is superior to all other animals. If this structural difference is important, as between man and ape, what about the difference between one man and another man? Are individual differences due to structural differences, or are they due to what man has learned, to the kind of environment in which he has lived?

These queries regarding structure and environmental influences lead to another statement of the problem. To what extent is a man's achievement the result of heredity and to what extent may learning account for his success? One extreme view—often attributed incorrectly to the social scientist—is that a person's total intellectual and behavioral development depends entirely upon his environment. The opposite extreme—also incorrectly attributed to the biologist—holds that heredity is the determining factor in the kind of person one is. An equally absurd assumption is that one may inherit physical traits—such as color of hair, height, weight, and so forth—but that "mental" traits—intellectual ability, or intelligence—are entirely a matter of training.

These three views are all popular misconceptions. The hereditary pattern never occurs, except in a certain environmental setting. Furthermore, we have already shown that behavior is entirely a matter of the activity of various parts

of the body in response to one's environment. This does not mean that these two factors cannot be varied independently within certain limits. They can. An individual with the hereditary equipment capable of extensive development can be stunted, both physically and psychologically, by being raised in unfortunate surroundings that neither require nor give him opportunity to develop to the level of which he is potentially capable. On the other hand, the richest and most wholesome environment is powerless to effect development in an organism that, through heredity, lacks the equipment and structural requisites to take full advantage of the opportunities afforded by his environment. Such variations simply emphasize the point that both are interdependent.

Take a simple example in plant heredity: In Iowa, a certain corn has been bred to produce tall stalks and big ears. If you plant some of this corn in Kansas, in Ohio, and back of the sand dunes in western Michigan, the yield of the corn planted in Kansas will be about equal to that in Iowa; that in Ohio may not do quite so well; but that planted in western Michigan will produce short stalks and extremely small ears. We have varied the environment but kept the hereditary factors constant, with the result that we have obtained wide differences in the corn plants. On the other hand, an inferior breed of corn planted in the best soil will not produce either the amount or the quality of corn that the better breed would produce. In other words, though the soil has a great deal to do with the quality of the produce, there is a limit to what fertile soil can do with poor seed.

But you may say: "This may be true for plants or even lower animals, but does it hold for human achievement?" A poor environment means poor food supply, which may stunt the growth of the child; but physical stunting would not interfere with his intelligence, provided he is placed in a good social environment, such as a progressive school. This is an extreme view which, strangely enough, is held by many educated people not familiar with the facts. They assume that heredity has nothing to do with the ability of the individual to develop his thinking and his emotional life.

Equally extreme is the assumption that all defects in human achievement—particularly crime, indigence, and other defects of personality—are wholly the result of inheritance; that is, that the criminal and the insane exhibit their maladies solely because of poor heredity. We shall see that both of these views are equally at fault. An individual's attainment depends upon his capacity for learning and for adjusting to his physical and social environment. He is therefore limited by this inheritance; but, on the other hand, the degree of his achievement will depend upon the environment in which he lives. HEREDITY AND TRAINING ARE INSEPARABLE.

In order to understand more clearly the place of heredity in human achievement, we must turn to the geneticist for more specific facts. This will temporarily take us away from our more distinctly psychological problems, but we shall come back to them with the data of genetic studies. From these data, we can draw certain inferences or set up hypotheses regarding the inheritance of certain mental functions. Then we must look for the evidence that may substantiate our hypotheses.

Chromosomes

The life of the individual starts when two germ cells unite. But each of these germ cells has had a history. The egg cell

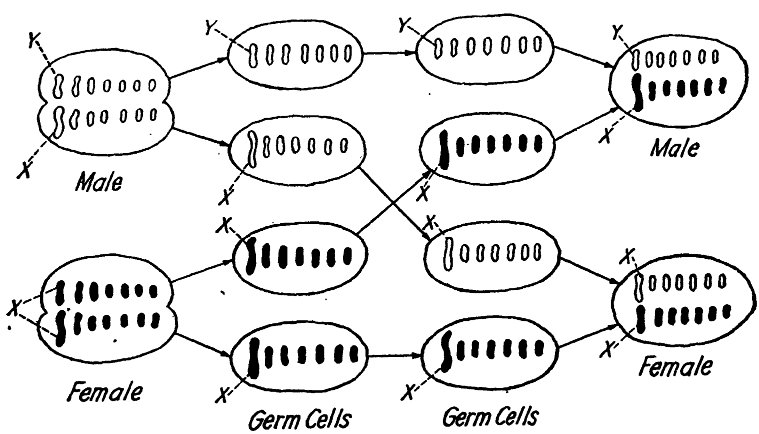

FIGURE 14.—THE ARRANGEMENT OF CHROMOSOMES. Not all forty-eight human chromosomes are represented. The *X* and *Y* chromosomes as determiners of male and female are also indicated.

(*ovum*) resided in the lining of the ovary. Within its nucleus were to be found forty-eight (twenty-four pairs) minute bodies of different size and shape, called *chromosomes* (Figure 14) because they can be stained by certain dyes. When the ovum is about to be released, the chromosomes divide into two groups, one of each pair taking its place in a group. Then the cell divides. We now have a cell with only half as many chromosomes, but it contains one of each of the original pairs. The same process is duplicated in the male sperm cells. As these meet, they join to form a single cell with a nucleus again composed of twenty-four pairs of chromosomes, each pair made up of one chromosome from the male and one from the female original cell.

This fertilized egg is already passing down the *fallopian tube* to the *uterus*. At the same time, growth is taking place, the single cell dividing and again redividing. By the time it reaches the uterus, it has acquired microscopic tendrils by which it is able to become attached to the wall of the uterus. From this time on, it is a parasite on the mother's body. But no blood of the growing embryo is obtained from the mother. What happens is that certain chemicals—principally sugars, fats, proteins, and important minerals—filter through the wall of the uterus from the blood of the mother; and with these chemicals, the embryo constructs its own food supply. Even in the later stages, when the fetus has developed a circulation system, its blood is of its own manufacture. It can be seen, therefore, that the blood stream offers no way in which the mother can influence the child after fertilization except as she supplies, or fails to supply, the proper nourishment in the form of chemical constituents of a growing organism. Similarly, there is no direct connection between the nervous systems of mother and child. At an early stage in the growth of the embryo, the neural groove can be identified. This groove ultimately becomes a tube and soon differentiates into the brain and spinal cord. Branches of neurones grow out from this tube to all parts of the organism. Soon the heart begins to beat, and a little later the head and limbs will move when stimulated by changes in pressure. It will be seen, therefore,

that there is positively no way in which the mother's mental life can directly affect the child.

One other fact must be noted regarding development of the child: Body cells stem from the fertilized germ cell, but germ cells do not originate from body cells. Even the process of division is different. Whereas the fertilized germ cell originates by the union of half of two nuclei, each carrying half of the chromosomes of a sperm and ovum in the body cells, the chromosomes of one cell split lengthwise, forming double the number of chromosomes. These rearrange themselves into two groups, and then the cell divides into two cells. Germ cells continue their own course from the beginning. What happens to the body cells cannot influence them. SINCE ALL THAT IS PASSED ON TO THE NEXT GENERATION IS THE GERM CELL, HALF OF IT FROM EACH PARENT, NOTHING THAT HAPPENS TO THE INDIVIDUAL IN HIS LIFETIME CAN HAVE A HEREDITARY INFLUENCE UPON THE NEXT GENERATION UNLESS IT HAS AFFECTED THESE GERM CELLS.

Genes

Evidently, the chromosomes are the carriers of heredity; but how? We often hear such remarks as: "He gets his eyes from his mother, his nose from his father, and some other feature from one or another of his grandparents." Still more puzzling is the fact that he may not resemble either parent or either of his grandparents. If these features are actually inherited, how can lack of resemblance be explained?

LITERALLY THOUSANDS OF CAREFULLY CONTROLLED EXPERIMENTS HAVE LED THE GENETICIST TO POSTULATE GENES IN THE CHROMOSOMES, AND IT IS THESE THAT DETERMINE THE SPECIFIC CHARACTERS THAT ARE INHERITED. No one has ever seen a gene, but it is just as real to the geneticist as is the atom to the chemist or the electron to the physicist.[1] Many of the discoveries of the operation of the genes have been determined by the

[1] This statement is not quite true. Very recently "giant" chromosomes have been discovered in the caterpillar stage of the fruit fly. When these chromosomes are viewed under high magnification, structures are seen which may be the genes. Furthermore, the relation of these structures to the anatomical characteristic corresponds to that of the postulated genes.

study of inheritance in the common fruit fly (*Drosophila melanogaster*), which is a convenient little insect for this purpose. Its life span corresponds to man's, if we substitute days for years; and individuals of the species differ in eye color, eye shape, and other characteristics, as do humans. It would take us too far afield if we attempted to show how the geneticist has arrived at the conclusion that the genes are responsible for inheritance. However, it is important that we consider the geneticist's description of how these tiny particles operate:

Imagine the genes of the chromosomes as tiny beads strung together on a string. Some of these account for eye color, skin color, straight and wavy hair, the shape of the nose, and other characteristics of size and shape of the parts of the organism. Each organism, therefore, carries many units that may determine what the individual inherits. How these will act depends upon the combination of the genes derived from both parents. It may be that each one in a pair of genes represents a particular trait, such as brown eyes. The offspring, in this case, will inherit brown eyes. Or, it may be that the gene derived from one pair represents brown eyes and that from the other blue eyes, and still the offspring will have brown eyes. The reason for this is that the gene for brown eyes is *dominant*. Now suppose that this individual mates with another brown-eyed individual who carries the same genes—that is, one for brown and one for blue eyes. Their offspring may have either brown eyes or blue eyes, depending upon which genes are transmitted to the offspring, because each parent carries blue as a *recessive* gene. It will be seen by reference to the diagram in Figure 15 that these genes may combine in any one of four ways: two brown-eye genes make one pure brown-eyed offspring; the two recessive blue-eye genes make one pure blue-eyed offspring; or the blue and brown may combine to make two other pairs who are brown-eyed but carry blue-eye recessives.

Sex is also inherited. It has been found that, in the female cell, there are two large chromosomes known as the *"X" chromosomes*. In the male cell, there is one large *X* chromosome and one small *Y* chromosome. If the fertilized cell receives an *X* chromosome from the female cell and an *X* chromosome

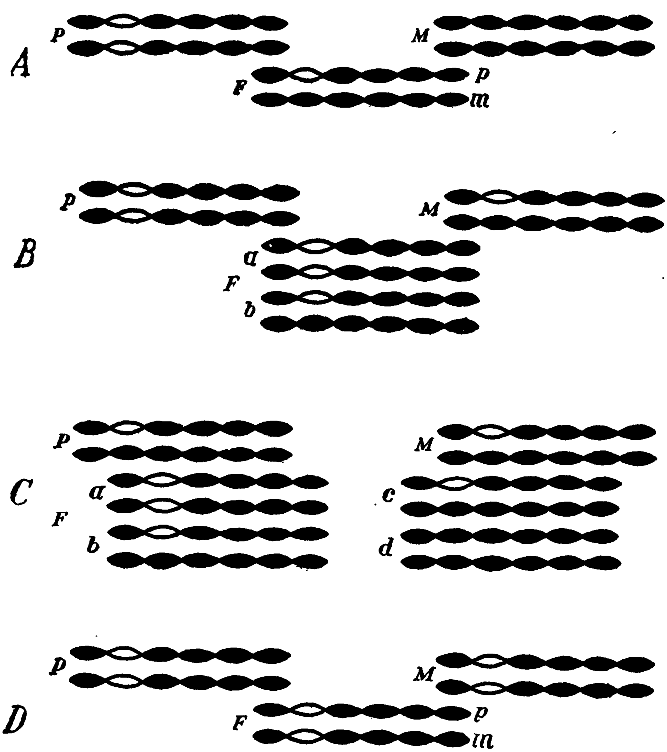

FIGURE 15.—GENE COMBINATIONS. *P* and *M* are chains of genes in two parents, and *F* represents possible arrangements in the offspring. In *A*, the father possesses two defective genes (white), while the mother has corresponding normal genes. Since the child receives one set of genes from each parent, it has in all pairs at least one normal gene and is, therefore, not personally defective. Other possible combinations are shown in *B, C,* and *D.*

from the male cell, the offspring will be female. If, on the other hand, the fertilized cell receives one *X* and one *Y* chromosome, the result is a male. The study of these chromosomes has demonstrated that the genes of the *X* chromosome are dominant. For example, if a male is color-blind—that is, relatively insensitive to red or green—neither his daughter nor his sons will show this defect, because this is a recessive trait. The gene for color-blindness is dominated by the normal gene of the other *X* chromosome. In the next generation, the sons of

the daughter may be color-blind, because she passes on the *X* chromosome containing the defective genes to the sons and daughters; but the sons have received a *Y* chromosome from the father, and therefore this *X* chromosome dominates the *Y* chromosome. There are many other ways in which genes have been found to determine the inheritance of specific traits, but we must leave the details to the geneticist and turn to studies of the possibility of the influence of inherited structure upon psychological achievement.

The only reason for going into the matter of hereditary mechanisms in such detail here is to impress upon you that, at birth, every individual is already equipped with those devices by means of which he is to make his adjustment to his environment; because, just as we inherit eye color, hair texture, and skin pigment from our ancestors, we also inherit from them a nervous system, a muscular system, and the other response mechanisms that were discussed in the previous chapter. When we realize the dependence of behavior upon structure, we cannot in one breath admit that physical characteristics are inherited and in the next contend that one's psychological development is not also predetermined in part by one's hereditary background.

Intelligence and heredity

We all recognize that some individuals display greater ability to deal with new situations than others. One student seems to be more able to remember a great many facts; another is able to analyze a situation and reach valid conclusions in a discussion. Sometimes we say that Mr. *A* is a "genius," Mr. *B* is "very bright," and Mr. *C* is "rather dull" or even "feeble-minded." We sometimes hear the statement that so-and-so has a "good mind." Or, again, we say that a student is "very intelligent but lacks personality." In the course of a few weeks, we make literally hundreds of judgments about people in these terms or in similar language. The tragedy is that most of these popularly stated judgments are highly inaccurate. If we were simply "calling people names," this inaccuracy might be regrettable, hardly tragic. As it turns out,

though, we proceed to act on the basis of these names by treating a person as though he really were "feeble-minded," let's say. Much of psychology is concerned with trying to determine intellectual status precisely and to provide thereby a factual basis for classification, labeling, or "name-calling."

What do we mean when we say that a person has a "good mind"? And can we say that this good mind has been inherited? Really, a "good mind" signifies that the individual functions unusually well in the situations in which we find him. He not only is able to learn and remember a great many significant facts, but he can discriminate between what is worth remembering and what is unimportant. He can make good discriminations regarding social problems, and he can work independently to a greater extent than the average person. To the psychologist, this means that, as an organism, he is so constructed that he reacts to his environment in ways which are superior to other individuals. IF WE WERE TO USE THE TERM, THEN, "MIND" MIGHT REFER TO THE FUNCTIONING OF THE ORGANISM AS IT ADJUSTS TO THE COMPLEXITIES OF THE PHYSICAL AND SOCIAL ENVIRONMENT.

Intelligence is another term that is often used with a variety of meanings. We speak of the "intelligence" of some of the lower animals, meaning that they do some things that seem very complex. For example, the beaver appears to select the proper place and builds a dam that is adequate for his purposes. Some dogs are capable of learning to point, and many other animals show significant signs of complex behavior. When we discover that many of these acts are very routine and do not show the significance of adaptation to changes in environment, we are inclined to say that the animal is not as "intelligent" as we had supposed. This indicates that we are thinking of intelligence as involving something more than automatic behavior. In other words, we feel that the capacity to learn must be involved in intelligent behavior.

Frequently, however, the term *intelligence* is applied to what the individual has accomplished, as if intelligence could be improved by learning. Thus, it would be said that the dog is intelligent because he can point or perform certain tricks, and

the student is supposedly more intelligent after he gets his degree than he was before he entered college. This is a confusion of the terms *attainment* and *intelligence*. "INTELLIGENCE" IS A TERM THAT SHOULD APPLY TO THE CAPACITY OR ABILITY TO LEARN, PARTICULARLY IN COMPLEX SITUATIONS. This capacity is dependent upon the structure of the organism. In this sense, then, we can say that intelligence, as structure, is inherited. THE "ATTAINMENT" OR LEVEL OF BEHAVIOR THAT THE INDIVIDUAL REACHES, IS DEPENDENT UPON THE CAPACITY OF HIS STRUCTURE AND THE OPPORTUNITY AFFORDED BY THE ENVIRONMENT IN WHICH IT MATURES.

Intelligence tests. At the beginning of the century, it was thought that students not doing well in school were simply lazy and that all they needed was harsh treatment to show them the folly of their ways. In the early part of this century, the French psychologist, Alfred Binet, was commissioned to distinguish between the bright and dull pupils in the schools of Paris. For this purpose, he organized a set of tests which he believed to be fair to all children living in Paris, regardless of the amount of schooling they had already received. These tests led to an interest in the possibilities of measuring native endowment of children in America; and for this purpose, the Binet tests have been revised and refined to meet the requirements of American children. One specific principle in the development of these tests was the assumption of a common environment, namely, that ALL ITEMS IN AN INTELLIGENCE TEST MUST BE OF THE SORT THAT ANY CHILD WOULD HAVE HAD AN OPPORTUNITY TO LEARN.

The first step, therefore, was to collect a great variety of items and arrange these in approximate order of difficulty for children of different ages. These items were then given to a large number of children in various parts of the United States, both in large cities and in small communities. On the basis of these results, items were selected for each age group.

For example, for the seven-year group there are six tests, as follows: [2]

[2] Terman, Lewis M., and Merrill, Maud A., *Measuring Intelligence* (New York: Houghton Mifflin Company, 1937).

1. *Giving the Number of Fingers*
   Ask:

   a. "How many fingers have I on one hand?"
   b. "How many on the other hand?"
   c. "How many on both hands together?"

   If the child begins to count in response to any of the questions, say: "No, don't count. Tell me without counting," and repeat the question.

2. *Memory for Sentences II*
   Say: "Listen; be sure to say exactly what I say":

   a. "Betty has made a pretty dress for her doll out of blue ribbon."
   b. "My baby brother wants Santa Claus to bring him a great big drum."

3. *Picture Absurdities I*
   Three pictures:

   a. Man on limb.
   b. Man on scales.
   c. Cat and mice.

   Show the pictures in the order indicated, and ask for each in turn: "What's funny (foolish) about that picture?" If the child's response is ambiguous, without further explanation ask: "Why is it (that) funny (foolish)?"

4. *Repeating Three Digits Reversed*
   Say: "I am going to say some numbers, and I want you to say them backward. For example, if I should say 5-1-4, you would say 4-1-5. Ready now? Listen carefully, and be sure to say the numbers backward."

5. *Sentence Building I*
   Say: "I'm going to tell you something about dog—cat: 'The dog runs after the cat.' Now you make a sentence about:

   a. Horse, bigger, dog.
   b. Boy, fell, leg.
   c. Child, flowers, meadow."

6. *Counting Taps*
   Say: "Listen; I am going to tap on the table, and I want you to tell me how many times I tap. Listen carefully.

For the eight-year group, there are the following tests:

1. *Comprehension III*
   Ask:
   a. "What should a man do if he comes home and finds that a burglar has robbed his house?"
   b. "Why is a train harder to stop than an automobile?"
   c. "What should a man do if he finds that he is earning less money than it takes to live on?"

2. *Similarities: Two things*
   Say: "In what way are . . . and . . . alike?"
   a. Mosquito and sparrow.
   b. Window and door.
   c. Bread and meat.

3. *Verbal Absurdities I*
   Read each statement and, after each one, ask: "What is foolish about that?" If the response is ambiguous, without further explanation ask: "Why is it (that) foolish?"
   a. "A man had flu (influenza) twice. The first time it killed him, but the second time he got well quickly."
   b. "Walter now has to write with his left hand, because two years ago he lost both his arms in an accident."
   c. "A man said: 'I know a road from my house to the city which is downhill all the way to the city and downhill all the way back home.' "
   d. "An old gentleman complained that he could no longer walk around the park as he used to; he said he could now go only halfway around and back again."

4. *Naming the Days of the Week*
   Say: "Name the days of the week for me."

5. *Problem Situations*
   Say:
   a. "About two o'clock one afternoon, a number of boys and girls, dressed in their best clothes, rang the bell at Alice's house. Alice opened the door. What was happening?"
   b. "Helen heard a big 'Bang,' and came running outdoors. There were nails all over the road, and an automobile had just stopped beside the road. What was the 'bang'?"
   c. "A young man and lady were sitting in a restaurant. They had nearly finished eating a big dinner. The waiter brought the bill. The young man looked at it, and then seemed worried and embarrassed. Why?"

6. *Opposite Analogies II*
Say:
a. "The rabbit's ears are long; the rat's ears are . . . ."
b. "Snow is white; coal is . . . ."
c. "The dog has hair; the bird has . . . ."
d. "Wolves are wild; dogs are . . . ."

It is also necessary in scoring the tests to adhere to the standards of performance that have been determined as satisfactory answers by the investigators who constructed the scale. Furthermore, the examiner must be able to get the fullest cooperation of the child. His judgment as to whether this rapport exists and whether the child is in good physical condition —free from fatigue, illness, and so forth—is a result of his own intelligence and training, which must be taken into account. This is why only the *trained* psychoclinician should give tests of this kind for diagnostic purposes.

Mental age and intelligence quotient. If a seven-year-old child is able to pass all the items that are prescribed for the seven-year test, he is judged to possess "normal" intelligence. His *mental age* (*M.A.*) corresponds to his *chronological age* (*C.A.*). If, however, he is able to pass all the eight-year tests as well, his M.A. is 8, a year above his C.A. It is desirable to have some convenient measure for comparing children of different ages. When we learn that the M.A. of one child is twelve and that of another is fourteen, this tells us little about their intelligence, unless we know the C.A. of each. Even then we are left to estimate their relative standing.

To facilitate such comparisons, the *intelligence quotient* (*I.Q.*) is generally used. This is determined by dividing the mental age by the chronological age and multiplying this quotient by 100, in order to avoid fractions. Thus, a child ten years old, with a mental age of twelve, would possess an I.Q. of 120, while the twelve-year-old whose M.A. is fourteen would have an I.Q. of 117. Both are two years advanced; but relative to their C.A., the younger is superior. Instead of having to make vague comparative statements about children, this method supplies a precisely determined index number which quantifies our estimate of intellectual status.

The I.Q. and heredity. Tests may be used for a great variety of purposes. In this chapter, we are concerned with the use of these test scores in making clearer the relation between inheritance and environment by observing their effect on these scores. If the environment is the same for all children examined, we may assume that variations in the I.Q. must be due to variations in heredity.

If, now, we should transfer a child to a different community, what might happen to the I.Q.? If we assume that heredity is the only factor, then the I.Q. should remain constant. If the environment is the important or only factor, we should expect the I.Q. to change to conform entirely to the environment into which the child is placed. On the basis of what has already been said, it should be clear that we do not expect either of these extremes. As has already been stated, the achievement of the individual is dependent upon his innate capacity and the environment in which this has been given an opportunity for expression. How these two operate is illustrated by a study[3] of over 200 foster children who were compared with a corresponding group of children living with their true parents. These latter children we will call the *control group.* They were chosen to match the foster children in age, sex, and similar characteristics, and because their families matched the foster families for locality, type of neighborhood, and occupational field of the father.

The Binet test was given to all the foster parents and to the foster children. Likewise, it was given to the true parents and to their children. Other tests were used to determine the value of the environment, which is expressed in terms of economic index, cultural index, number of books in the home, vocabulary of the fathers and mothers, and so forth.

From all the data subjected to elaborate statistical analysis, we may draw some pertinent conclusions:

1. Children who live with their own parents more closely resemble them in intelligence-test scores than do children

[3] Burks, Barbara Stoddard, "The Relative Influence of Nature and Nurture on Development," in *Twenty-seventh Yearbook, The National Society for the Study of Education* (1928), pp. 219–316.

resemble their foster parents. This fact would indicate that heredity played some part in establishing the performance level. In part, the data led this investigator to conclude that heredity is five times as important as environment.

2. A good home environment, on the other hand, does have a beneficial effect upon the intelligence-test score as much as twenty I.Q. points in rare cases, according to this study.

All this means that we may *infer* that the environment may influence the achievement of the individual to quite a degree, but that his inherited structure places a limit on what he may achieve under the best conditions. The method used in this study is very important. You will recall that it consisted in comparing the intelligence-test scores of children and their parents—for the one group, actual parents; and for the other, foster parents. The same problem can be attacked in a different way by making use of the phenomenon of twinning.

The method of cotwin control. Everyone knows a good deal about the world-famous *identical* Dionne quintuplets, but it is not recognized that ordinary pairs of one-egg twins are quite numerous and of nearly as great scientific value as triplets, quadruplets, or quintuplets. Our interest in one-egg twins lies in the fact that, genetically, they are identical. They are to be distinguished from *fraternal* twins by the fact that the latter have originated from two eggs independently fertilized, and are therefore no more alike than two children in the same family born at different times. They may be brothers, or brother and sister, or sisters. One-egg twins, on the other hand, have originated sometime after fertilization by the embryo splitting into two. They therefore each carry the same genes. Consequently, in the case of one-egg twins, we may say that whatever differences appear between the two individuals must have been caused by differences in their environments, either before birth or in their later development. If we measure the I.Q. of many pairs of one-egg twins, we find that, on the average, the two members of a pair differ in I.Q. by about five points. This means that ordinary pairs of one-egg twins are almost as similar in respect to achievement as

they are in respect to their physical characteristics. For pairs of fraternal twins, however, the I.Q.'s are found on the average to differ about ten points.

This fact of greater similarity in intelligence among one-egg twins as compared to fraternal twins is usually accepted as reasonable evidence that most differences in intelligence are a matter of inheritance. However, some thoroughly scientific people have felt that this may not be the true interpretation. They accept the fact that physical traits of a pair of one-egg twins are similar, owing to heredity; but they point out the possibility that such twins may grow up to resemble each other in intelligence only because they are treated more similarly than two-egg twins. It is apparent that some kind of experimental control of these factors is essential before we can interpret the data more adequately.

Recently a biologist, a psychologist, and a geneticist published their results of a study [4] of fifty pairs of one-egg twins and fifty pairs of fraternal twins. In each case, these twins were reared together. Another group of nineteen pairs of one-egg twins were reared apart. This would give an excellent opportunity to study the similarity of twins reared together and the deviations of those who were reared in different environments. In general, the results clearly show that the one-egg twins reared together resemble each other more closely than do the corresponding two-egg twins. On the other hand, one-egg twins who are reared apart deviate from each other in ways that are related to the differences of their environments. We may cite two rather interesting cases:

1. Helen and Gladys, one-egg twins (Figure 16), were separated when they were two years old; and they never saw or heard from each other until they were twenty-eight years old. Helen was adopted by a farmer in Michigan whose wife, though uneducated herself, determined that Helen should have every educational opportunity. Helen graduated from college and taught a variety of subjects in school. Later, she married at the age of twenty-six and had one child.

[4] Newman, H. H., Freeman, Frank N., and Holzinger, Karl, *Twins—A Study of Heredity and Environment* (Chicago: University of Chicago Press, 1937).

FIGURE 16.—HELEN AND GLADYS. (From Newman, Freeman, and Holzinger, *Twins: A Study of Heredity and Environment.*)

FIGURE 17.—EDWIN AND FRED. (Reproduced by permission of *The American Weekly.*)

Gladys, on the other hand, was adopted by a railroad conductor in Ontario. As her foster father was transferred to the Rockies, Gladys had little opportunity for elementary education. She was also needed at home continually for housework, and had no occupation other than this until she was seventeen years old. Then she went to work in a knitting mill. Later, she did clerical work and became an assistant in a small publishing concern. She married at twenty-one and had two children.

These twins discovered each other when they were twenty-eight years old. When they were examined at the age of thirty-five, Helen exhibited a superiority of twenty-four I.Q. points—nearly five times as great a difference as in the case of the I.Q.'s of one-egg twins reared together.

2. The one-egg twins Ed and Fred (Figure 17) present an interesting case because of the remarkable parallelism in the lives these twins led without knowledge of one another's existence for twenty-five years. They were adopted in early infancy, and each one was led to believe that he was an own child. Though they lived 1,000 miles apart, they had about the same education; and both found employment as repairmen in the same telephone company. They were married in the same year, and each had a son. Each owned a fox terrier dog named Trixie. When Ed was twenty-two, a stranger who had come to his city greeted him with: "Hello, Fred, how's tricks?" A little later, someone again called him Fred, and inquiry led to the discovery that he had a twin living in a distant city. When they were tested at the age of twenty-six, Ed's I.Q. was 91 and Fred's was 90. We would not expect any closer agreement if the same individual were examined twice in succession.

These two cases represent extremes. If we should consider all nineteen pairs, we would find that the average difference in I.Q. was somewhat less than the difference in I.Q. for pairs of two-egg twins reared together. SUCH RESULTS ARE DIFFICULT TO EXPLAIN, UNLESS WE GRANT THAT SOME CONSIDERABLE PART OF THE INDIVIDUAL DIFFERENCE IN TEST INTELLIGENCE IS DUE TO DIFFERENCES IN HEREDITY. In each of the nineteen cases of identical twins reared apart, the pairs differed most when the

environments differed most, indicating the role of the environment. In those cases in which the home environments were of approximately the same level, the I.Q.'s were about as similar as for one-egg twins brought up in the same home.

Inheritance of special abilities

If such a general ability as intelligence is dependent upon innate factors, we may ask: "Is this also true of special abilities? Does the expert machinist inherit traits that are conducive to becoming an expert in this field? What about the expert calculators, great generals, and great statesmen?" It is very difficult to isolate the traits in such abilities and study them as we have seen intelligence studied with foster children and twins. However, so much interest has centered in the inheritance of artistic talent that we might discuss the status of our knowledge as it affects musical talent.

Is the great musician great because he has lived in a family of musicians, or does his greatness result from the genes he has received? If the factors of heredity and environment have not as yet been studied in isolation—that is, by holding one constant and varying the other—we must resort to the deductive method in order to reach a conclusion. We have seen that heredity is dependent upon genes; that sometimes a trait is the result of the gene from one parent, and in other cases a combination of genes from both parents is necessary. This latter situation is what we found in the case of the multiplicity of factors involved in what we call *intelligence.*

Musical talent depends upon the ability to make accurate discriminations of pitch, a good sense of rhythm, tonal memory, discrimination of resonance and dissonance, and many other simple discriminations. There still remains some ill-defined characteristic that the musician calls *talent.* We may therefore assume that many genes are responsible for the musical genius, if heredity plays a part in such special ability. Musical talent, therefore, is not a simple trait, but is dependent upon many factors. A recent inquiry [5] into the families of great

[5] Scheinfeld, Amram, *You and Heredity* (New York: Frederick A. Stokes Company, 1939).

musicians, including a number of outstanding artists of the Metropolitan Opera Company, attempted to determine to what extent musical talent is inherited.

Let us take the case of Kirsten Flagstad as an example. Figure 18 is a diagram of her family, indicating the musical and nonmusical members. A plus sign in the circle or square indicates that the individual possesses some degree of musical talent. A double plus indicates talent and also memory for absolute pitch, which is relatively infrequent in the general

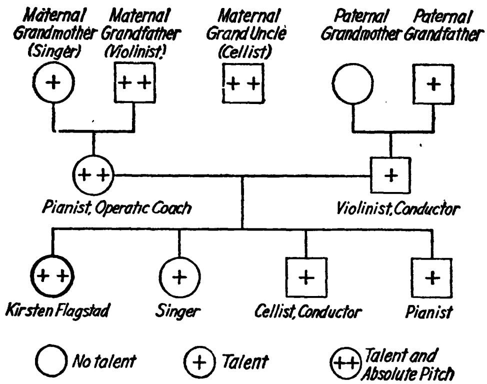

FIGURE 18.—KIRSTEN FLAGSTAD'S MUSICAL PEDIGREE. (Adapted from Scheinfeld and Schweitzer, *You and Heredity*.)

population. A blank form indicates that the individual possesses no known musical talent. It will be seen that Madame Flagstad's maternal grandparents were both musical and that her grandfather also possessed absolute pitch. Her paternal grandmother was nonmusical, her mother was both talented and possessed absolute pitch, while her father was talented. Her two brothers and one sister were all talented, though only she possessed absolute pitch. We might argue from this diagram that Madame Flagstad inherited musical talent because all but one of her ancestors were musical, as well as her brothers and sisters. On the other hand, we might argue with equal cogency that, since she had lived in a musical family that was derived from musical families, her musical environment had been responsible for her material success.

If, now, we consider another case—that of Arturo Toscanini—we find that neither of his parents, nor his two sisters or brother, was musical; yet he himself possesses musical talent to a very high degree (Figure 19). Toscanini married a woman who was somewhat talented. Of their children, only one—a daughter—appears to display any talent. She married Vladimir Horowitz, who is highly talented; and their child, at three and a half years, displays marked musical ability. This diagram argues strongly for the inheritance of musical talent, inas-

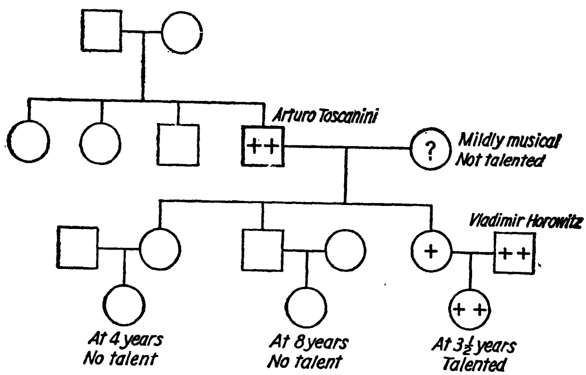

FIGURE 19.—THE TOSCANINI FAMILY. (Adapted from Scheinfeld and Schweitzer, *You and Heredity*.)

much as there is no indication of young Toscanini's having lived in a musical environment. His granddaughter's talent, on the other hand, might be ascribed to either her heredity or her environment.

We may go one step further in our deduction: If environment were the only factor, how could we account for the fact that Madame Flagstad's brothers and sister were not as outstanding in musical talent as she herself is? The answer seems to be that the factors in musical talent must be paired, one of each pair coming from each parent. In the distribution of genes, therefore, at the time of union of the two germ cells, one offspring may receive such a combination of "musical-talent genes" as to be outstanding in this ability, though neither parent possessed these genes in pairs. The random assortment of genes for musical ability would account for the fact that the outstanding talent appears in only one member of a family of

children. This fortuitous combination, coupled with opportunities of the environment for the development of its potentialities, accounts for such outstanding artists as Kirsten Flagstad and Arturo Toscanini.

There is one other factor that should be taken into consideration in all accomplishment: We must not forget that all great artists have acquired their greatness through long periods of arduous labor. It is reported that, for weeks, Paderewski practiced four hours a day on one concerto. THE DEVELOPMENT OF A PROFICIENCY IS THUS A MATTER OF LEARNING, BUT THE TIME REQUIRED FOR THE LEARNING MAY BE SHORTENED WHEN THERE IS A SPECIAL ABILITY PRESENT.

Contrasted with these artists is the man who, as a child of two, could carry the popular airs he heard in the family and early exhibited absolute pitch discrimination, yet who later did not possess the ability to work persistently on his music lessons —probably because he lacked the energy necessary for long, continued labor. This, then, is another important factor that may depend upon genes. Some individuals exhibit a great deal of energy, can work hard all day, and can carry on some type of activity late at night without showing fatigue. Other individuals tire very easily.

To summarize our conclusions, therefore, we may say that such specific ability as musical talent depends upon the inheritance of the right genes, the influence of a proper environment, and a physical capacity of enduring long hours of labor. LABOR ALONE WILL NOT CREATE MUSICAL TALENT OR ANY OTHER ABILITY. The individual of moderate ability may become slightly proficient in music through sheer effort, but his ceiling is low; whereas the individual who possesses the right genes may be only moderately successful because he makes only a small investment in energy toward developing his talent.

Inheritance of personality traits

In the beginning of this chapter, we raised the question: "Does one inherit the peculiarities of his parents if the father is irritable or the mother exhibits a phobia, such as an excessive fear of fire? Will either of these traits be inherited by the

child?" Studies have shown that physical traits, such as the color of eyes or hair, or the shape of nose and face, are more nearly alike in the case of one-egg twins than is intelligence, as measured by the intelligence test. In other words, the environment has a greater influence in determining achievement than it does in determining the color of one's eyes, for example. *Personality,* as we ordinarily use the term to mean *patterns of individual traits,* is still more dependent upon the environment, although it is also determined in a general way by the genes. One-egg twins, though they possess identical genes, may differ slightly in size because of slight differences in their environment and birth. We may assume that, as infants, these twins are placed in the same play pen. The larger twin bumps into the smaller one and topples him over. The result might be that the larger twin would learn to take advantage of the smaller and would become the *dominant* personality, while the smaller twin becomes *submissive.*[6] Many other incidental factors of this sort may have a decided influence on the development of the individual in his relation to other individuals. One enjoys taking the lead in all ventures; another gets equal enjoyment in following the lead of his companions. We may resemble our parents in many personality traits because we have lived with them—not because we inherited these traits. If your father gets his way by showing his temper around the house, you may very early adopt this same method yourself. If your mother shows an intense fear of fire, the chances are very good that she will teach you to fear fire too. Parents' testimony regarding whether they have or have not taught their children such habits is usually none too reliable.

What we have inherited are genes, which determine the structure and potential development of the organism. What the organism becomes as a social individual depends upon the training it receives in its family and social environment.

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[6] Blatz, W. E., *The Five Sisters* (New York: William Morrow and Company, 1938).

4

Maturing and Learning

If we were to summarize the material in the preceding chapter in a single sentence, the sentence might run something like this: HEREDITY LAYS THE GROUND PLAN FOR THE DEVELOPMENT THAT IS TO TAKE PLACE DURING THE LIFE OF THE INDIVIDUAL, BUT BOTH THE EXTENT OF THE DEVELOPMENT AND ITS DIRECTION ARE ALSO STRONGLY INFLUENCED BY THE ENVIRONMENT IN WHICH THE INDIVIDUAL LIVES. An environment which is entirely deficient in certain respects will prevent the maximum development of inherited capacities along those lines. On the other hand, heredity sets certain limits beyond which the individual cannot develop, no matter how favorable the environment. This is an important principle for you to remember. You will have occasion to run into it many times in your everyday life. It is an especially basic consideration in all matters involving education in general, as well as specialized training.

It now becomes necessary for us to examine the development of behavior a little more closely. First, we must make a distinction. Behavior development can be of two kinds: *maturing* and *learning*.

"MATURING" REFERS TO CHANGES IN BEHAVIOR THAT ARE PRETTY MUCH THE RESULT OF THE GROWTH OF THE ORGANISM. We might say that *maturing* and *growth* are almost synonymous. As the organism grows older, it becomes stronger; it can do things that it could not do at an earlier age. There are more subtle developments, however, which occur with age. Very early in the life of the organism, the changes that occur in the nervous system are of great importance. While it is

true that the newborn infant has about as many neurones as it ever will have, especially those in the central nervous system are still growing at this early stage in life. It takes some time for this part of the nervous system to become structurally mature. If you remember that the chief function of the central nervous system is integration, it is not surprising that the behavior of the very young infant is most elemental. Other developments are also taking place in the young child.

This growth of the nervous system, and similar changes taking place in muscles, size and proportions of the bones, teeth, and so forth, are what we mean by the term *maturing.* The role of the glands—particularly the sex glands—in the behavior of the organism also seems to become more pronounced with age, although the time at which they exert their greatest effect is not definite. As you may imagine, these developments may be almost directly traced to heredity. But even here, heredity and maturation are not entirely responsible for the changes in behavior that we note. Unless the proper environment is encountered, certain of these changes will not take place at all. On the other hand, the particular type of environment that is encountered may determine which of several possible directions maturation will take. The next few pages will give some illustrations of this point.

Before we go further, however, there is another term to be defined. A great many very intelligent men have scratched their heads and stroked their beards over the exact meaning of the word *learning.* In psychology, however, you will find that THE TERM "LEARNING" REFERS MOST FREQUENTLY TO THOSE CHANGES OR MODIFICATIONS IN BEHAVIOR THAT ARISE WHEN THE ORGANISM RESPONDS TO ITS ENVIRONMENT. Even this definition will not satisfy all the uses we make of the term. You will notice that there is nothing in it about practice, and that there is no mention of how permanent these changes must be in order for us to say that they are "learned." But this definition will meet most of our requirements, even though, in a later chapter, we may find it necessary to make it a little more complicated by qualifying or adding to it.

The basic nature of learning may readily be seen when we stop to realize that every response the organism makes to its environment brings about enough of a change so that it may be said that the organism is never the same once it has responded. Used in this way, you see, *learning* is almost synonymous with *living*. Indeed, there are many who would not separate the two terms. Be that as it may, however, it is true that living tissue becomes more or less permanently changed in response to environmental stimulation. This is more especially true of nerve tissue than most others, although we get much the same effect in inanimate objects, but not to the same degree. It can be demonstrated, for instance, that a soft iron rod becomes permanently modified if it is once placed in a magnetic field. We do not say, however, that the rod has "learned" anything. We usually reserve the use of the term to living tissue and, more than that, employ it almost exclusively to designate the changes that take place in nerve tissue.

These first few paragraphs contain two very important principles. Be sure that you understand them. They may not conflict seriously with anything you already know. But their newness and exactness and importance justify your close attention.

Behavior Development and the Nervous System

One of the neatest demonstrations of the dependence of behavior development upon the development of structure is the work carried out with tadpoles. Because of the almost prohibitive complexity of the problem, the demonstration was made with very primitive animals. As we shall see later, we have every reason to believe that the same principles apply at the level of the human organism. The investigator[1] chose the amblystoma because its body is long and slender, which makes it easier to observe its movements and to study the growth of its nervous system—the two factors that it was desired to correlate.

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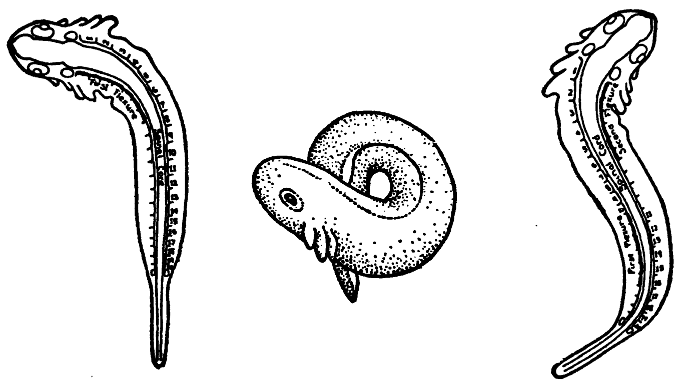
[1] Coghill, G. E., *Anatomy and the Problem of Behavior* (New York: The Macmillan Company, 1929).

First of all, the tadpole is the embryo stage of the organism. It corresponds to the fetal period of higher animals. The gross structures of the human infant are nearly complete at birth. Only the finer nervous structures continue to grow after this period. Hence, it would be difficult to identify just what structures were correlated with any specific response, even if we could get at its nervous system to investigate and compare the relations between structure and behavior. We



A B C

FIGURE 20.—THREE STAGES IN THE BEHAVIOR DEVELOPMENT OF AMBLYSTOMA. *A,* diagram to illustrate the first flexure stage; *B,* tracing of a photograph taken while the coil reaction was being performed; *C,* diagram to illustrate an "S" reaction in which the first flexure has passed tailward and the second flexure is beginning on the opposite side. (*Coghill.*)

know that the infant in the uterus moves and that it responds to stimuli. If, therefore, we can observe the behavior of a lower animal form in a corresponding stage of development, and then prepare microscopic slides of it, we can determine these relationships. This investigator did just this with the amblystoma (Figure 20).

Behavior stages of amblystoma

The results of these amblystoma studies indicated that their early behavior could be readily classified into five stages:

1. *The nonmotile stage.* This was a period of no movement, even when stimulated by a light touch. If, however, a needle

was inserted into a muscle, this muscle contracted, resulting in a flexion on the same side.

2. *The early flexure stage.* A light touch on one side resulted in a slow bending at the head end, away from the side touched. As the embryo advances slightly in age, the flexions extend further down until the entire trunk is involved (Figure 20A).

3. *The coil stage.* Soon after the second stage, a touch on the side results in a quick flexion into a coil on the opposite side. This coil may be reversed immediately into a coil in the opposite direction (Figure 20B).

4. *The "S" stage.* This reaction is characterized by a reversal of the flexure before it is completely executed as a coil. As the wave of contraction passes down one side, a second wave starts at the head end on the other side (Figure 20C).

5. *The swimming stage.* Swimming is effected when the *S* reactions in series are sufficiently strong and rapid to propel the embryo through the water.

The correlated neural structures

At each developmental stage outlined above, some of the tadpoles were placed in a fixing and hardening solution, and then sectioned into very thin slices for microscopic examination. With the aid of these sections, it was possible to construct diagrams of the relationship existing between neurones and muscles, as shown in Figures 21 and 22. The results may be summarized as follows:

1. *The nonmotile stage.* There are afferent (sensory) neurones, as shown in the left part of the diagram of Figure 21, with their dendrites, or receiving branches, in the skin and muscles. However, the connections between these, at x, are incomplete. Therefore, it is necessary, in the nonmotile stage, to stimulate a muscle directly—as by a needle—in order to elicit a response. This is why the flexion is toward the side stimulated. The muscle that is pricked contracts.

2. *The early flexure stage.* The neurones in the medulla (x), which, up to this time, possessed only one branch, become

bipolar and complete the connections between the sensory neurones and the motor neurones of the other side. This accounts for the fact that a stimulus on one side elicits a flexion toward the opposite side.

3. *The coil stage.* With further growth of these neurones, the nerve impulse passes more readily from one to another.

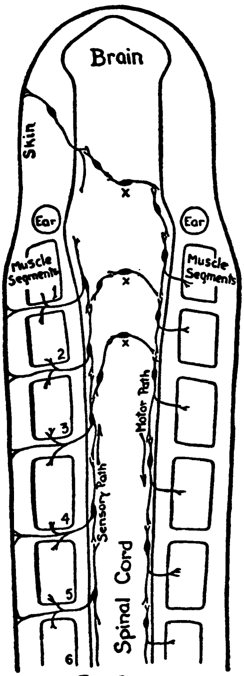


FIGURE 21.—DIAGRAM OF MECHANISM WHICH ACCOUNTS FOR THE COIL REACTION. (*Coghill.*)

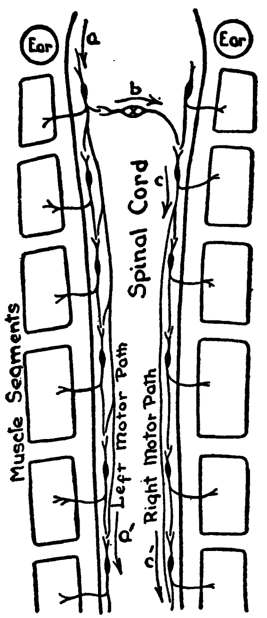


FIGURE 22.—DIAGRAM OF THE NEUROMOTOR MECHANISM OF SWIMMING. The sensory mechanism is omitted. (*Coghill.*)

Hence, all the muscles on one side may be set into contraction in rapid succession (Figure 21).

4. *The "S" stage.* Two factors play a part in the behavior at this stage: (*a*) As the muscle segments contract, as a result of stimulation of dendrites in the skin of the opposite side, dendrites in these muscles are stimulated; and this impulse is transmitted, by a series of neurones, to the medulla (*x*) and progressively downward to muscle segments on the other side.

(*b*) The axones and their collaterals become greatly elongated, reducing the necessary number of connections. This facilitates the transmission of the nerve impulse. Consequently, as a flexion progresses down one side, it is soon followed by a flexion, starting at the head, on the other side.

5. *The swimming stage.* Further growth of the collaterals, as shown in Figure 22, results in sufficient speed and strength of alternating flexions that swimming is effected.

An important confirmation

As a check on the findings of the investigation just described, amblystoma, at the time of hatching, were placed in a weak solution of chloretone.[2] This procedure anesthetized the animals but it did not interfere with their normal growth. Five days after a control group began to swim, the drugged specimens were removed to tap water, which washed out the anesthetic. The first movements were evidenced in an average of twelve minutes; and within the next thirty minutes, several specimens swam as well as the control group. Table II gives the time in minutes required for the first movements by the sample specimens.

TABLE II

TIME IN MINUTES FOR FIRST MOVEMENTS IN DRUGGED TADPOLES

Number	*Amblystoma*	*Frog Tadpoles*
1	14	10
2	25	14
3	9	11
4	7	7
5	6	9
6	8	15
7	8	15
8	7	..
9	24	..
10	13	..

One might ask whether the lapse of time before movements were observed in the drugged tadpoles was due to the time re-

[2] Carmichael, L., "The Development of Behavior in Vertebrates Experimentally Removed from the Influence of External Stimulation," in *Psychological Review* (1926), Vol. XXXVIII, pp. 51–58; (1927), Vol. XXXIV, pp. 34–47.

quired to remove the anesthetic, or whether it did not represent a partial learning period in the stimulating environment. This question was answered by anesthetizing specimens that could swim. It was found that the time required for first movements when these specimens were transferred to tap water was practically the same as for the first group of drugged specimens. It is clear, then, that the behavior exhibited in these investigations is dependent upon the neuromuscular structure present at each successive stage of development.

Other experiments with animals

The findings in amblystoma have been verified with investigations of the pecking response in young chicks. Investigators[3] kept the newly hatched chicks in complete darkness over a period of days. The chicks were fed by hand in the dark. They were fed by placing bits of soft food in their beaks. Water was administered with a medicine dropper. Each day, some of the chicks were taken out and allowed fifty trials at pecking at small grains. The number of successful hits was recorded. Some chicks started at the end of the first day; others, on the fourth, fifth, or sixth day. Each day thereafter the same number of trials was given. The results shown in the graph of Figure 23 indicate that, on the first day of trials, the chicks in every case made a low score. On the second day, those that we may designate as the "control group," and that started at the end of the first day (*S*), reached a relatively high score and continued to improve more slowly from then on. Those that started pecking on the fourth day (*I*) improved, starting more rapidly at first and actually reaching the same degree of accuracy on the second day that was reached on the fourth day by the control group. Those that started on the fifth and sixth days improved still more rapidly, and eventually all four groups were pecking with the same degree of accuracy.

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[3] Shepard, J. B., and Breed, F. S., "Maturation and Use in the Development of an Instinct," in *Journal of Analytical Behavior* (1913), Vol. III, pp. 274–285.

Other experiments[4] with the pecking of chicks have not completely verified these first results. Those that started later improved, but not more rapidly than the control group. Eventually, however, they all reached the same degree of accuracy. One exception to this statement is the result of an experiment in which the chicks were allowed no opportunity to

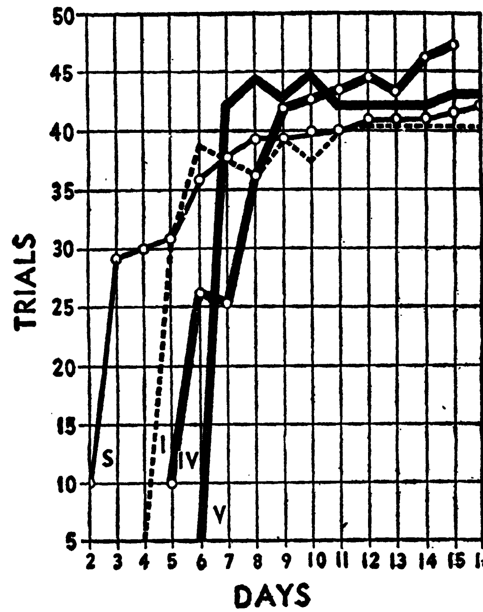

FIGURE 23. CURVES SHOWING IMPROVEMENT IN THE PECKING OF CHICKS. (*Modified from Shepard and Breed, p. 278.*)

peck for a long period. It was further found that these chicks never learned to peck.

WE MAY CONCLUDE, THEREFORE, ON THE BASIS OF THESE EXPERIMENTS, THAT DELAY IN OPPORTUNITY TO EXERCISE A FUNCTION MAY NOT SERVE TO PRODUCE A PERMANENT RETARDATION; IN FACT, THERE IS SOME EVIDENCE TO INDICATE THAT THE SPEED

[4] Bird, Charles, "Maturation and Practice: Their Effects upon the Feeding Reaction of Chicks," in *Journal of Comparative Psychology* (1933) Vol. XVI, pp. 343–366. Also: Mosley, Dorothy, "The Accuracy of the Pecking Instinct in Chicks," in *ibid.* (1925), Vol. V, pp. 75–97.

OF LEARNING WILL BE GREATER, OWING TO THE ASSUMED INCREASE IN THE GROWTH OF THE STRUCTURES INVOLVED. On the other hand, restriction for too great a period may interfere with the function. Presumably, in the specific case referred to, the chicks had learned to depend upon being fed, and this became a substitute for the pecking response.

Growth and Achievement

We have seen that the Binet test was devised to distinguish between bright and dull pupils. This test was constructed on the theory that a child of seven years is capable of doing things that a child of six years cannot do. This led to the mental-age concept. Thus, we may say that a child with a chronological age of ten years gives evidence on the test of a mental age of eight or nine years, or a mental age of ten or eleven years. This indicates that he is so much above or below what is to be expected at his age. At one age, a child in a normal environment is able to define objects in terms of use—a chair, for example, is something to sit on. At a later age, the test requires a more complete description in order to pass the test.

The results of these tests, therefore, in the case of a normal child, are the results of his growth or of the maturation of structure, as well as a measure of what he has learned. If we wish to determine how much effect maturation has on the performance of the individual, we could solve our problem by restraining the child so that he would not have the opportunities to learn in the normal manner. Or, we could institute intensive training and compare him with others who have been given the ordinary opportunities to learn. This has been done for us, although, until recent years, the observations were not carefully controlled.

Feral children

We frequently read in the papers accounts of feral, or wild, children. The story of Romulus and Remus was a myth that may have had some validity, as undoubtedly there were children at that time who were left entirely alone and survived.

Recently, there have been accounts of two girls who were seen by natives coming out of a den with the wolves. A missionary in Bengal secured these children, and reported that they behaved very much like wolves. Amala, the younger child, died soon after her capture, but her sister, Kamala, lived for several years. The missionary reports that she would howl in the middle of the night, that she went on all fours and preferred to eat like a wolf. She would steal chickens, alive or dead, and eat them in the bushes like a wild animal. She learned but few words and few of the human modes of behavior.

Another famous case, reported during the latter part of the eighteenth century, was that of the wild boy of Aveyron. Little was known at that time regarding the nature of intelligence, but Itard, in Paris, took the boy and attempted to train him. But painstaking and ingenious instruction failed, and Itard was driven to the conclusion that the boy was congenitally feeble-minded.

We are therefore left in doubt, regarding Kamala and the wild boy of Aveyron, as to what would have been their development if they had been brought up in normal home environments from the beginning. Were they feeble-minded because they had been born with defective structures, or were they deficient because they had been given no opportunity to develop?

The case of Isabelle

A more illuminating case is that of a young girl, recently discovered, who, until she was about six and a half years old, lived isolated in a room with her deaf-mute mother. When she was discovered, she showed evidences of malnutrition and other signs of neglect. Investigation indicated that Isabelle's mother was of inferior intelligence, a so-called "borderline case," but not actually feeble-minded.

Isabelle was completely mute when she was taken to the hospital. It was therefore impossible to give any verbal tests at that time, so that she was given performance tests, which consisted of arranging blocks to make a figure or of placing odd-shaped boxes in a form. On the basis of all the tests

that could be given, it was estimated that her performance was about the equivalent of that of a nineteen-month-old child. At the end of a year and a half, her test performance had risen to a level about equal to an I.Q. of 80.

This rapid rise is indicated in Figure 24. The curves (P.A.[5] equals 100, P.A. equals 80, and so forth) represent the progress of a child under normal conditions. It will be seen that there is a gradual rise over the years in the curve marked P.A. equals 100. There is a similar rise in the last curve, although it is

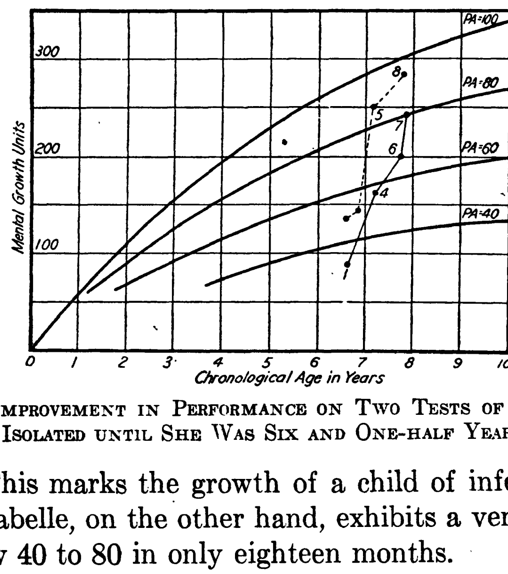

FIGURE 24.—IMPROVEMENT IN PERFORMANCE ON TWO TESTS OF A CHILD WHO WAS ISOLATED UNTIL SHE WAS SIX AND ONE-HALF YEARS OLD.

slower. This marks the growth of a child of inferior intelligence. Isabelle, on the other hand, exhibits a very rapid rise from below 40 to 80 in only eighteen months.

Another girl, whom we may call Anna and who was the same age, had been isolated during the same period in another family. Reports indicate that she has not shown as rapid progress as Isabelle. We may conclude, therefore, regarding these two children, that Isabelle was greatly retarded because of her isolation; that, under normal conditions, she would have exhibited a nearly normal intelligence. Anna, on the other hand, has not shown recovery and, like the wild boy of Aveyron, may be considered as congenitally defective.[6]

[5] *P.A.* stands for *per cent of average*. For example, P.A. equals 100 for the curve of growth of the intelligence of the normal child; P.A. equals 80 for a curve representing a growth that is eighty per cent normal.

[6] Unpublished paper by Dr. Francis Maxfield.

The effects of moderate restriction

One psychologist reared a pair of fraternal twins under carefully controlled conditions. Their activity was restricted by their being kept on their backs in cribs, screened from each other, and cared for only by the psychologist and his wife, who took every precaution to limit the children's social as well as physical environment during the first year. The infants were given no opportunity to sit or stand, and the opportunities to reach objects were reduced to a minimum. Smiling and other facial expressions on the part of the attendants were restricted as much as possible. The infants were carefully observed as to the time when responses occurred, and these were checked with a list that had been standardized for infants under normal conditions.

As a result of this restricted environment, the infants exhibited each new response at a later period than the latest time of appearance for these same responses by children reared under normal conditions. As soon as the opportunity was given to practice these responses, however, each response was established with a minimum of practice and was perfected without any social encouragement.[7]

To study further the effects of restricted activity, this investigator studied the behavior of the Hopi Indians. Some of the Hopi still bind their infants upon boards. They wrap a blanket over the right arm and the body; then the other edge of the blanket is wrapped over the left arm and tucked over the right side. The lower end is folded under the legs and buttocks of the infant. The infant is then tied to the board by strips of cloth. There is some freedom of movement of the head, but the rest of the body is held immobile. The child remains in this position except for a few moments once or twice a day. After three months, the time spent on the board decreases, although night sleeping and day naps are always on the board. The board is usually used for six

[7] Dennis, W., "The Effect of Restricted Practice upon the Reaching, Sitting, and Standing of Two Infants," in *Journal of Genetic Psychology* (1935), Vol. LXVII, pp. 17–32.

months, but may be used for a longer time. Mothers were interviewed as to when the child took a first step in walking alone. Since it was possible to check many of the reports, and since the mothers evinced a willingness to co-operate, the investigators were convinced that the mothers were quite accurate in their reports. When the data were compiled for those children who had been bound to the board and for others in the same community for which the board had not been used, it was found that the time of walking was very close to fifteen months for both the restricted and the unrestricted infants. It would seem, therefore, that restraint of activity had not retarded the age at which the first steps were taken.

BOTH OF THESE STUDIES INDICATE THAT, DURING THE PERIOD OF RESTRAINT, THE INFANTS MUST HAVE BEEN MATURING IN THE PHYSICAL STRUCTURE NEEDED FOR THE RESPONSE PATTERNS UNDER INVESTIGATION. THIS IS SHOWN BY THE ACCELERATED LEARNING THAT ENSUED AS SOON AS THE OPPORTUNITY FOR EXERCISE WAS GIVEN.

Co-twin Control

Another means of evaluating the place of growth in achievement is by use of "identical," or one-egg, twins. As the two in this case have the same genes and presumably nearly identical development at any one time, it is possible to train one twin and keep the other under more or less restraint for a given period and then compare the two in the performance desired.

In one experiment at the beginning of the forty-sixth week, training was given to one twin (*T*) in stair climbing and the piling of cubes. This was continued until the fifty-second week. During this time twin *C*, the control, was given no training. Beginning with the fifty-third week, *C* was trained for two weeks. Distinct differences were noted in the behavior of the twins. *T*'s early reactions to training were relatively passive, and she needed assistance. At the end of the fifty-second week, she climbed the stairs in twenty-six seconds. *C*, at the age of fifty-three weeks, without previous training, climbed the stairs unaided in forty-five seconds; and at fifty-five weeks, she climbed them in ten seconds. On the whole,

C was superior to *T* at the end of *C*'s training period, even though *T* had been trained three times as long. We may conclude that a child may learn this type of task more readily at the age of fifty-five weeks than seven weeks earlier. There is, however, a weakness that needs to be considered: During the period of training for *T, C* was not entirely inactive. Certain manipulations, creeping, and possibly walking would have

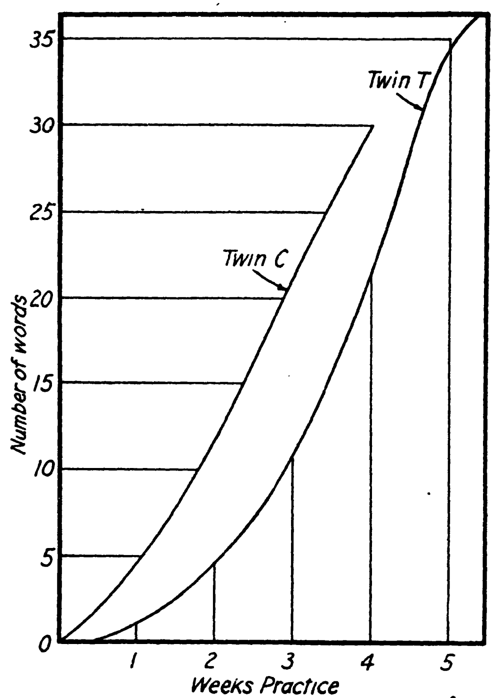

FIGURE 25.—CURVES SHOWING THE EFFECT OF AGE IN LEARNING VOCABULARY
Twin C started training 89 weeks later than Twin T.

some influence in the later manipulation of the cubes and the stair climbing.[8]

In another quite different experiment, one twin was trained in the development of vocabulary. The investigator played with *T* an hour and a quarter every day, presenting objects

[8] Gesell, Arnold, and Thompson, Dorothy, *Learning and Growth in Identical Infant Twins,* Genetic Psychology Monograph, No. 1 (1929), Vol. VI, pp. 1–124.

and naming them. This was continued from the eighty-fourth to the eighty-ninth week. He also played with *C* an equal length of time, but no words were used. Humming was substituted for verbalizing. At the end of the eighty-ninth week, *C* began the same training, and progressed more rapidly than *T* had done. This is more clearly shown in Figure 25, in which the curves of learning are superimposed according to the training period and without reference to the age difference. Again, it is seen that age is an important factor in learning.[9]

Few children are given any inducement to sing accurately, particularly to reproduce tones if they are presented to them. In one investigation, fourteen children approximately three and a half years old were trained for forty ten-minute periods to reproduce eleven or more pitches and twelve intervals of

TABLE III

THE EFFECT OF TRAINING ON THE REPRODUCTION OF TONES AND INTERVALS (JERSILD)

Group	*Initial Test*	*Retest After Training Period*		*After Period of No Training*	
	11 Tones	*11 Tones*	*18 Tones*	*11 Tones*	*18 Tones*
Practice....	4.7 (3.0)*	10.8 (2.5)	16.0 (1.6)	10.9 (0.15)	16.8 (1.5)
Control....	4.5 (3.2)	6.21 (2.8)	7.9 (3.2)	7.0 (3.4)	10.2 (4.8)
	12 Intervals	*12 Intervals*	*22 Intervals*	*12 Intervals*	*22 Intervals*
Practice....	4.38 (3.5)	11.76 (0.48)	19.0 (2.9)	13.3 (1.1)	18.69 (3.9)
Control....	4.46 (3.1)	7.61 (2.8)	9.0 (3.5)	7.4 (3.6)	9.8 (6.26)

* The numbers in parentheses express the average deviation (A.D.) of the averages given above them. The A.D. is a measure of variability. It is obtained by first determining the difference between each measure and the average—the mean, in this case—and then computing the mean or average of these differences, disregarding the signs plus and minus. The A.D. is large for the results with the untrained subjects, but decreases markedly with training in this case.

[9] Strayer, L. C., *Language and Growth, the Relative and Delayed Language Training Studied by the Method of Co-twin Control,* Genetic Psychology Monograph, No. 3 (1930), Vol. VIII, p. 110.

the octave. Table III gives the results of this experiment. It will be noted that the training group and the control group of fourteen were paired for equal ability on the first test. After the training period, the practice group was considerably above the control group, and this superiority persisted over a period of six months during which there was no training.

Social maturity

While a delay in opportunity to exercise a certain function may be offset by greater maturity and hence greater speed in learning, if the restriction is too great, the individual may be handicapped by other habits. When the chicks were fed by hand for too long a time, they failed to learn to peck, presumably because they had learned to depend upon hand feeding.

Many children are deprived of the opportunity to become independent because of too great solicitude on the part of a doting parent. The infant is carefully supervised for fear he will get bumped or pick up a germ. The little boy is not allowed to play with other little boys because he may learn naughty words. He is told when to put on his coat and mittens, what to do and what not to do at every turn.

Some men and many women students reach college without ever having purchased any article of clothing independently. They have never made a decision about their dress or their meals. It is regretful to see freshmen come to the campus in the fall piloted by father or mother, who selects a room, consults the student's adviser, and pays the tuition. Such a student is *socially immature*. He must now start in to learn what he ought, little by little, to have learned since he first began to walk. Some of these students are able to make the readjustment without their instructors or some other person in their community, or they flunk out and go home. Imagine college women who depend upon the matron of their dormitory to tell them when it is too cold to go out without stockings!

Learning

Before we turn to other experiments and demonstrations of the role of learning, we should note one or two things that sometimes escape attention: In the first place, learning prob-

ably begins in the fetal period. We sometimes fail to realize that the human embryo is active for many weeks before birth. *Activity* here means *behavior;* and, as we have already learned, behavior is always in response to some environmental stimulation. Now, of course, the environment of the embryo is a relatively simple one, and the responses that are being "practiced" are relatively simple responses. But the fact that the infant shows even the slightest signs of co-ordination in its behavior at birth is evidence that some improvement has occurred. As a matter of fact, some observations of the fetal behavior of certain animals have shown that most of the responses that are exhibited at birth are present to a rather complete degree fairly early in the gestation period. The remainder of the time before birth gives opportunity for the further integration of these responses, as well as the increase in strength that results simply from maturation. Such movements, for instance, as the sucking response, the alternation of fore- and hind-limb contractions that appear in swimming, and the rudiments of the righting response are good illustrations of this phenomenon.

If now you go back to the earliest period of infancy, you may ask: "What response patterns are there to be modified in the response repertoire of the newborn infant?" At birth, there are very few, if any, definite response patterns that have not been learned. The infant cries and makes many random movements. He breathes; his heart has already been functioning for many weeks. Certain *reflexes,* or simple responses —such as grasping or clenching the hands and moving the eyes in pursuit of a bright object—may be listed. Nursing is a very complicated response, and this usually requires a certain amount of practice before the total complex response is fully developed.

As the organism develops, other responses appear from time to time, without any apparent learning. Chance alone can account for the appearance of some of these new behavior items. But we shall see that the integration, or building of patterns of behavior out of these random movements, comes about only when opportunity is given the individual organism

to take some active part in his adjustment to the requirements of his environment. When you learn a poem or a chapter in your text, you are organizing patterns that already exist into new patterns that meet these particular situations. In learning a poem, you are already able to read; you can pronounce the words more or less effectively. But now you are arranging them in a new order. When this order is finally acquired, you say that the poem is "learned" or the substance of the chapter has been "mastered."

Many of your previous skills and much of your previous knowledge have been conducive to this learning. If the poem is of the type you have learned before, or deals with material that is familiar to you, you may find it easy to learn. If the chapter deals with some phase of psychology that is closely related to your own experience, either in the sense that you have read something of the sort before or that you have met with circumstances similar to those discussed, you may find it quite simple.

On the other hand, some of your previous behavior may interfere with this learning. Certain phrases in the chapter may lead you astray, as the cue to statements that you have learned in another context. Your prejudices regarding certain phenomena of human nature may interfere with your understanding of what the author is trying to impart, even though you are not aware that you are biased.

Knowledge and skill

We usually speak of *skill* as the ability to perform certain acts, such as using a machine, painting a picture, or doing anything that requires the use of our hands or other members of the body. "Knowledge" is more frequently thought of as the acquisition of facts or principles that are prominent in our surroundings and independent of the processes involved in the acquisition of a skill. ACTUALLY, WHAT WE TERM "KNOWLEDGE," IN THE CASE OF ANY INDIVIDUAL, IS HIS ABILITY TO RESPOND IN CERTAIN WAYS—USUALLY VERBALLY—AND THESE ARE VERBAL SKILLS. You have learned certain dates in history; you are able to name the members of the Presi-

dent's Cabinet or to conjugate a Latin verb. This is knowledge. But the ability to recite, even to oneself, means that the individual has learned to respond in these ways.

Frequently, you find yourself in the predicament of "knowing" some fact but of being unable to state it. This is of the same order as possessing a general knowledge of the use of a certain tool but lacking the ability to use it properly. Some things that are learned are called *knowledge* or are assumed to involve "the mind"; while others are called *habits* or *skills,* and it is assumed that they are more or less automatic in their involvement of the muscles. This is merely a form of classification, and strictly there is no difference between the two. The acquisition of skill and the acquisition of knowledge are both functions of the total organism.

Conditioned response

One of the essential factors in learning, though not the only one, is what we commonly call *association.* BY "ASSOCIATION," OR "CONDITIONING," WE MEAN SIMPLY THAT A RESPONSE BECOMES ATTACHED TO A NEW STIMULUS—A STIMULUS ORIGINALLY NOT EFFECTIVE IN ELICITING IT. A good example of establishing an association is the case of the child who is given castor oil with orange juice. The castor oil, of course, is repulsive to him; and ever after he may dislike orange juice because it was associated with his repulsion for castor oil. Undoubtedly, many foods are enjoyed because they were eaten for the first time under very pleasant conditions. Two boys returning from a camping trip praised the wonderful things they cooked in the woods; but when these foods were prepared at home by their mother, doubtless much better than they had prepared them in camp, they were quite disappointed in the outcome. This food just didn't taste the same.

We also have experimental evidence in the laboratory of the establishment of these associations. A notable example of this was the work of the Russian physiologist, Pavlov, who gave to this aspect of learning the name *conditioned reflex.* By a slight operation, Pavlov tied off a portion of the submaxillary gland of the dog and made a small incision, so that

when the dog salivated, a portion of the saliva would flow from this opening. The dog was placed on a table and secured by a harness facing a mechanism for presenting food. A tube attached to the opening below his jaw led to a recording instrument, so that every time the dog salivated, the degree of salivation would be recorded by this instrument. Then a bell was rung at intervals, and it was noted that no salivation took place. On the other hand, when food was presented, the dog salivated, as we might expect. The food was considered an unconditioned stimulus, and the response in this case an unconditioned response. After these preliminary tests, a bell was rung and food presented. After a number of repetitions of this combination of bell and food, the bell alone was rung. Finally, it was found that the bell alone would call forth the salivary response. The bell then became the conditioned stimulus, and salivation to the ringing of the bell was a conditioned response. WE MAY THEREFORE STATE THE GENERALIZATION THAT, IF A STIMULUS THAT PREVIOUSLY DID NOT CALL FORTH A SPECIFIC RESPONSE OCCURS OFTEN ENOUGH WITH A STIMULUS THAT DOES, IT WILL EVENTUALLY INITIATE THE RESPONSE.

The concept of the conditioned reflex has been broadened to *conditioned response,* because the term *response* is not limited to a simple movement but implies that a whole group of stimuli and responses are operative in what at first seems like a simple movement. For example, Pavlov found that the dog must be hungry and that the conditions in the room must be exactly the same at all times. On one occasion, the buzzing of a fly was enough to upset the whole experiment.

While a great deal of our own learning may be described as a *process of conditioning,* it does not tell the whole story. Your interests, the social group with which you live, your previous knowledge, and the needs of the moment are all factors contributory to the learning process. Some of these factors, as we have earlier suggested, interfere with the learning process. It is difficult to give up old habits. Old habits are constantly interfering with the acquisition of new skills.

Another point that must be emphasized is that all learning

involves action of some kind. The precept that "we learn by doing" is just as true today as it was forty years ago when first promulgated. This simply means that, when you attempt an act of skill, such as a drive in golf, each trial is an opportunity for hitting upon the proper organization to make the drive effective. When you read a passage in your text with an attempt to understand its content, you may partially establish the right responses. The second reading may bring about still further organization of the material. On the other hand, the student who "reads over" the material two or three or more times may be doing exactly the same thing each time, and little or no learning is established. IT IS NOT THE NUMBER OF REPETITIONS BUT THE ORGANIZATION THAT TAKES PLACE WITH EACH REPETITION THAT COUNTS.

Rote and substance learning

We frequently make a distinction between the ability to repeat word for word what has been learned and the ability to reproduce the general content or the facts expressed in a passage that has been read. It is sometimes a great advantage to repeat word for word what has been read. At the same time, it is usually essential that we understand the material as well. More frequently, we should be able to give the substance without reference to whether the exact words are again employed. Mathematical and chemical formulae must be learned in their exact form, unless we have available a reference book. In a course in political science, on the other hand, rote learning would not be a great advantage. It is necesary that the student remember movements in government and the causes underlying them, but it is not essential that he repeat in the exact words what he has read or been told. Although these two types of learning are alike in many respects, there are apparently some important differences.

In one experiment,[10] a group of students were given a passage to read three times. Immediately following, they were

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[10] English, H. B., Welborn, E. L., and Killian, C. D., "Studies in Substance Learning," in *Journal of Genetic Psychology* (1934), Vol. XI, pp. 233–260.

given a set of items to be marked "true" or "false" on the basis of whether the statements agreed *in substance* with the passage. Some of the items were in the exact wording of the text. Other items expressed the general idea of the whole paragraph and did so in language different from the original. Still other items, of course, were false and either did or did not conform to the wording of the text. The two types of items were irregularly grouped together and nothing was said about their differences. This test was repeated twenty-four hours later and also fourteen and thirty days after the original reading.

The scores on the items that were exact restatements of the original text decreased through the thirty-day period. The scores on the items that dealt with the substance of the paragraph improved on the successive tests. Just why the substance material should not only be remembered but also improved with time, while the exact statements or "rote learning" should be forgotten more readily, is a question not fully answered at the present time. There are several hypotheses that need further investigation.

In both types of learning, however, you can see that the task set for the student is to organize responses—in one case, simple responses as they have occurred in the reading; in the other case, a more complex organization of patterns expressing concepts involved in a simple sentence by any type of response that can be substituted adequately for the original sentence.

Youth and Age

We have examined enough evidence to convince us that learning is an essential feature of the development of behavior. With the possible exception of certain elemental vegetative functions, everything the adult human does can be shown to have been affected by learning. We have also emphasized the importance of the structural growth of the organism as a necessary basis for psychological development. In this respect, two facts have been outstanding:

FIRST, IT WAS SHOWN THAT DIFFERENT AGE LEVELS OF ACHIEVEMENT WERE SHOWN TO BE DEPENDENT UPON CORRE-

SPONDING LEVELS OF MATURATION OF THE STRUCTURAL COUNTERPART.

THE SECOND IS A COROLLARY OF THIS FACT, NAMELY, THAT, AT EACH AGE LEVEL AND FOR EACH INDIVIDUAL, THERE IS A CEILING BEYOND WHICH HE CANNOT RISE IN ACHIEVEMENT.

Additional training may raise the accomplishment of an individual beyond the normal, but there is a limit to this improvement. Proper training may make a feeble-minded person a safe and useful citizen in his proper place, but no amount of training will make him superior.

The peak of achievement

If it is true that achievement depends upon maturation as well as on training, when does the individual reach his limit? Growth must stop sometime. Does he go on acquiring knowledge and also improving his ability for achievement? This is a difficult problem to solve. We cannot adequately compare the young and the old by resort to such tests as the Binet because they have been standardized on children and youth. Questions or problems that are satisfactory for the child may not suit the situation for the adult. Furthermore, what motivates the child may have no appeal to the adult. The best we can do at present is to approximate equal conditions and, by the use of all the evidence, arrive at only tentative conclusions.

In one investigation, 823 individuals ranging in age from 7 to 92 years were given the same tests.[11] It was found that, for this test, the high point was reached at about the eighteenth year. Then the scores—gradually at first, and then more rapidly—decreased, until at 85 years the scores were 62 per cent below the 18-year scores.

In another study by one of the same investigators,[12] various tests of manipulation were used. One of these, the pursuitmeter, required that the subject keep a point on another mov-

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[11] Miles, C. C., and Miles, W. R., "The Correlation of Chronological Age and Intelligence Scores from Early to Late Maturity," in *American Journal of Psychology* (1932), Vol. LXIV, pp. 44–78.

[12] Miles, W. R., "Age in Human Society," in *Handbook of Social Psychology,* edited by Murchison (1935), pp. 596–682

ing point. Another was a measure of reaction time to an auditory stimulus. Three of the curves, representing performance at different ages, are reproduced in Figure 26. Here again it will be noted that there is an increase up to about twenty-five to thirty years, and then a slow decline. It would seem therefore, on the basis of these data, that we reach our greatest ability by our early twenties. We hold this advantage for a few years, and then begin to retrogress into old age.

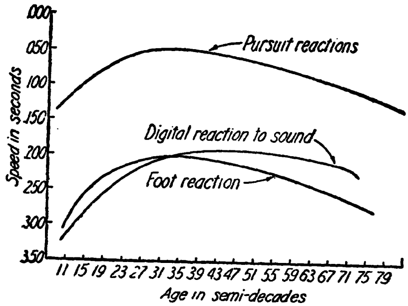

FIGURE 26.—CURVES REPRESENTING REACTION TIME AT DIFFERENT AGES.

The age of production

Another line of evidence regarding the relation of age to achievement is obtained by compiling, by years, the published works of noted men in science, literature, and music. Such compilations indicate—as shown in Figure 27 [13]—that, *on the average,* the period of greatest productivity is in the late twenties for poetry, in the early thirties for chemistry and physics, and in the early forties for mathematics and astronomy. Musical compositions, particularly orchestral music and grand opera, are frequent in the thirties and forties. It is evident, therefore, that the peak of production in these fields is reached rather early in life, although this does not mean that these individuals do not continue to be productive in their later years.

These findings, so far as they relate to the capacity at different age levels, may be criticized on the grounds that they show only the age at which the achievement appears. They do not take into account the creative work that has been going on during the preceding years. A man may spend many years getting established in his business or profession. During these years, he may receive barely enough remuneration to pay his expenses. If he is successful, he may be wealthy in later life.

[13] Lehman, H. C., "The Creative Years," in *Scientific Monthly* (1937), Vol. XLV, pp. 65–75.

The scientist or artist spends many years in study. These are the years of education, but his great productions in the thirties are the results of his earlier efforts. He has been creating or discovering all along, although it has not been evident. If this view is true, we may conclude that the evidence of capacity in the earlier years has been delayed. Those years were just as important as the thirties.

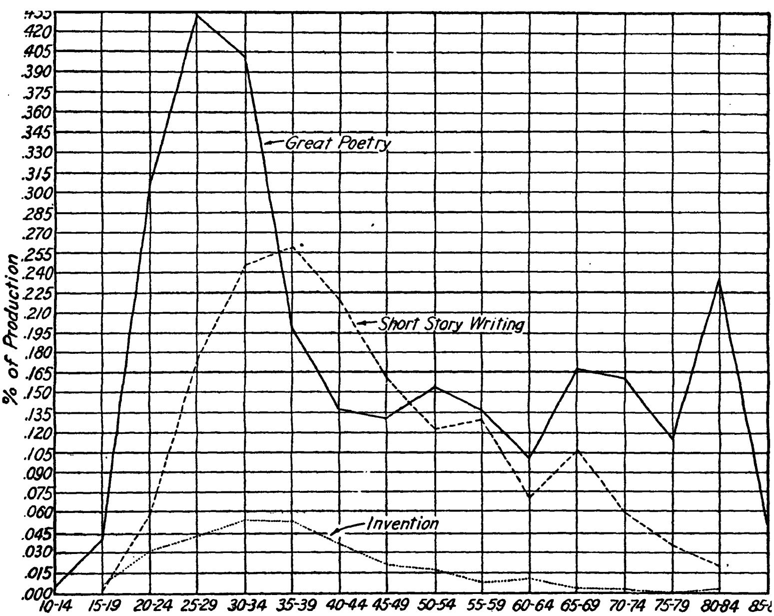

FIGURE 27A.—CURVE SHOWING THE AGE OF GREATEST PRODUCTION IN POETRY, STORY WRITING, AND INVENTION.

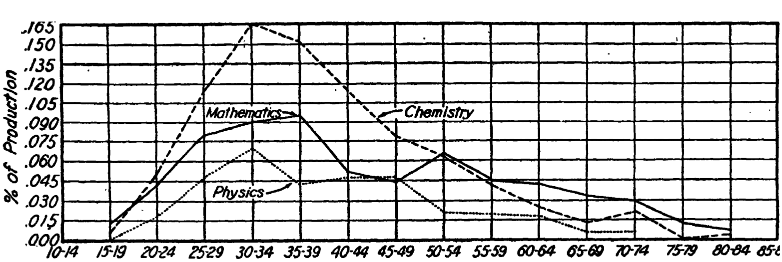

FIGURE 27B.—CURVES SHOWING THE AGE OF GREATEST PRODUCTION IN MATHEMATICS, CHEMISTRY, AND PHYSICS.

The falling off of productiveness in later life (forty to sixty years) is due to several factors:

1. There is a slow waning of energy. Physiologists recognize that the peak of physical fitness is at about thirty-five to forty. We might expect intellectual capacity to parallel physiological capaciy.
2. The motive to produce is not so great. It is a common failing of man to rest upon the laurels already won. The young man is struggling for position; the older man is more likely to be satisfied with the position already attained.
3. Productions in the later years are likely to be obscured by previous attainments, which are really only hints at great achievements that are elaborated in later years.
4. The orientation and judgment of the older man, in his forties or fifties, are likely to be more stable. Many young men have wasted their energies on projects that never materialized in worth-while production. These men are not taken into account in the studies of the productive years mentioned above because they were eliminated by their mistakes, their faulty thinking, or their misguided enthusiasm.

The older man possesses some qualities of superiority, even though he has passed the age of maximum structural fitness to learn and to produce. First, even though his capacity is not so great, he has had the benefit of his years to accumulate knowledge, and he is still learning. He has met obstacles and has learned how to cope with them. The older judge or the older general may be more stable in his decisions because he can anticipate, on the basis of previous experience, what the outcome of his decision may be.

There are many indications that such studies do not tell the whole story regarding man's useful years. The Chinese "street courts" are a good example. If the Chinese get into a dispute that, in our country, would be taken to court for settlement, they call upon an old man to hear the case and act as final arbiter. The judges of the United States Supreme Court are usually old men. Few professors are young men. Business executives are usually past fifty. The fact that older men

hold positions of authority does not alone argue for the desirability of the arrangement. In a crisis, the intelligent younger man may be more able to meet new situations. He is not hampered by years of habits that are no longer applicable to the times; his greater energy, alertness, and flexibility render him the superior of his elders.

Summary

On the basis of the evidence presented we may conclude that:

1. During the growing years, the level of development, or maturation, determines the complexity of the skills or other adjustments that can be learned.
2. Regardless of the uniformity of behavior within a species, the establishment of response patterns is generally dependent upon learning for their perfection.
3. A delay in opportunity to react to the environment, within limits, is not detrimental to the acquisition of these adjustments.
4. There is evidence that we continue to increase in capacity, for some skills at least, up to the late twenties or thirties.
5. From about the thirties on, decline in the capacity to learn or to make new adjustments sets in.
6. In later years, the physical decline is partially offset by the accumulation of experiences. The older man is still gaining in knowledge and skill, only more slowly.
7. Learning is a process of organization of reaction patterns through the reactions to environmental situations.

5

Motivation and Morale

Some of the many problems the psychologist should answer include such questions as: "Why do men behave the way they do?" "Why do we have such things as war, panic, riot, class struggle?" "Why are some people greedy and others generous?" "Why do some men struggle all their lives against insuperable odds to attain a goal, while others give up at the slightest provocation?" We must admit that, for the psychologist who could answer all of these questions, a special place should be reserved in the world's Hall of Fame. Yet, even the scope of the questions does not prevent the average person from flinging them at the social scientist, with an air of expectancy that frequently turns into a resentful disappointment when the answers are not immediately forthcoming.

As a matter of fact, questions of this tenor have bothered mankind ever since he became seriously interested in the problems of his own behavior. That the questions are still being asked is simply good evidence of their profound nature. The persistence of the questions is also evidence of another point, namely, that the answers that have been offered have not proved satisfactory. We must realize that many attempts to answer these questions have been made. Most of the historically important answers have posited some kind of basic motivating influence. To some, this urge has been of divine origin: "All human endeavor is motivated by the rational soul." On such bases, whole religions have been founded; and the lives of millions of people are governed by the axioms,

postulates, and laws that follow from such a basic proposition. Another semireligious answer has assured us that man is instinctively evil; that, from birth, he is possessed of degrading influences. This is the so-called "doctrine of original sin," which is very old historically and is accepted by many people at the present time.

Economic systems have been built upon assumptions of some fundamental principle of human nature. An economist may assume that man is basically, innately, and universally philanthropic, generous, kindhearted, and helpful; that any evidences in man's behavior to the contrary are simply the result of the unfortunate imprint of the civilization in which man is forced to survive. Upon such an assumption the economist might build up a whole system involving answers to questions of values, distribution of wealth, division of labor, and other matters of interest to him. Such a system would be logical, complete, airtight, and foolproof. Its only drawback would be that it would not work out in actual practice. The chief reason for the failure would lie in the error of the original assumption. Another economist might assume that man is basically, innately, instinctively acquisitive, selfish, and pecuniary; that all of his behavior, regardless of how it appears on the outside, is directed by an inward urge toward self-aggrandizement. This economist could also build up a "perfect" economy, the chief disadvantage of which would be the simple fact that it, too, proves faulty in operation.

Perhaps we may begin to suspect why these answers to the questions about the motives of men have not proved to be satisfactory. All of these attempts have been in the direction of seeking universal and ultimate causes where no such causes exist. They have all been concerned with a single postulate designed to define man's "original nature," and have either neglected entirely or placed very little emphasis upon the enormous contribution of training. A point of view at the other extreme would contend that we might expect men to behave similarly only when their training had been identical; that differences in basic urges and desires are attributable en-

tirely to the particular environment in which a personality develops.

During the preceding chapters, we have spent a great deal of time acquainting ourselves with the evidence indicating that the adult is a product of both his structure and the environment in which he lives. Since the contributions of these two sources are infinitely complex, we should expect men to differ greatly among themselves. The same point of view would lead us to expect, not only differences between men, but also contradictions within each man. We shall see presently how often the latter is the case; how it is possible for a man to be both selfish and philanthropic, both a gentleman and a beast. But in our analysis and description of human motives, we shall continually be on the alert to establish the background of each; to learn just what the starting point may be and the conditions that determine the direction of the development.

Some Typical Motives

Conformity

Nearly all people develop some motives that we may consider common to the group. We all develop the habit of conforming more or less strictly to the customs of those about us. It is the easiest way to get along. For example, we dress pretty much alike. Students today do not wear long coats or grow beards; nor do they wear long dresses that sweep the floor. Those changes that take place conform to the style, or *mode* —that is to say, it is the most frequent way of dressing. You do not follow the style because it is the most esthetic. If you want to become acutely aware of the true reason, try living for a day on the campus in a derby hat or cut-away coat. Perhaps you have been forced to appear with white paste on your face or with a hand bandaged. Then you realize how inconvenient it is to appear different. Or, perhaps you undertook to violate a custom, one of the folkways of the community. You find that you can get further in this social world

by conforming; hence you develop the motive or desire to conform in nearly everything.

A good example of conformity is the habitual observance of traffic laws. Observers placed at corners where there were cross-traffic and boulevard stop signs counted the number who actually stopped, slowed down, or crossed at the same speed.[1] Figure 28 indicates the results of this survey of 2,114 motorists. Seventy-five per cent of the motorists conformed to the letter

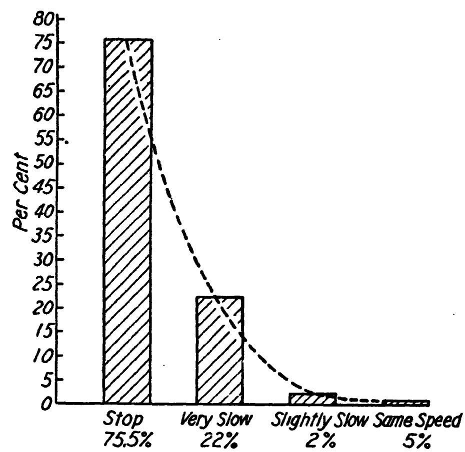

FIGURE 28.—BAR GRAPHS INDICATING CONFORMITY OF MOTORISTS TO TRAFFIC SIGNALS.

of the law, while the remaining 25 per cent violated the law to some degree. This obedience to law was taken as a matter of course by most of these drivers. To some, of course, it was simply the fear of getting caught by a traffic cop. Another motive may also have played a part. The 22 drivers who definitely slowed down may have conformed to "safety," although they did not conform to the law.

Why did these motorists conform at all? Two obvious reasons are: fear of arrest, and recognition of danger of accidents. Back of these are training and social convention. "Keep off the grass" and "No smoking" have little effect in our community unless a policeman is in sight. We learn to

[1] Allport, F. H., "The J-curve Hypothesis of Conforming Behavior," in *Journal of Social Psychology* (1934), Vol. V, pp. 141–183.

respect some laws and to violate others. Traffic laws are too frequently violated because present traffic conditions are relatively new. Twenty years ago, at a busy downtown intersection, the traffic police were in serious danger of being run over. Motorists would not stop for any signal, saying: "The streets are free; they belong to the public." Today, the same city is having trouble with parking meters. Although for many years parking has been restricted, with no parking in certain areas, the old argument of "individual liberty" is again heard.

The same principle of the dependence of conformity on social factors and training applies to college life. In one college, cheating is severely punished by the student body; the culprit is ostracized. In another, the tables are turned: the student who reports cheating is ostracized. In one university, a student may get gloriously drunk on a week end; but if he so much as takes one drink after twelve o'clock on the day preceding the annual ball, he is in honor bound to absent himself from the ball. And it is reported that the rule, in the latter instance at least, is observed. There is no argument for some of these customs, inside or outside of college. In many cases, they once had a logical basis and now are retained through force of habit.

"CONFORMITY" THUS, IS SIMPLY THE NAME WE GIVE TO THOSE HABITS THAT PRODUCE IDENTICAL OR VERY SIMILAR BEHAVIOR IN GROUPS OF PEOPLE. There is nothing innate or mysterious about it. As you discover that certain similarities between your behavior and the behavior of others produces a desirable and pleasant adjustment, these similarities become more and more marked.

Pre-eminence

Conflicting with the desire to conform to the group is the desire for individuality, for self-expression, and the necessity for attracting attention. Some persons become so highly motivated toward expressing their own individuality that we say they are "self-centered" or "self-conscious." Many adolescents are "problem" boys or girls because they resist any

attempts to line themselves up with the group. But the real difficulty often lies deeper than that. Certain disturbing circumstances have thrown them out of line with the group, and the strong urge to be oneself is expressed in erratic behavior. It is better to gain recognition by being "antisocial" and be punished than to remain a nonentity. When such a boy or girl finds an opportunity to be outstanding in a socially acceptable performance, he is generally satisfied, and his maladjustments disappear.

Take the case of a boy who was a constant source of disturbance in the schoolroom. He took no interest in the classwork, bullied the other boys, and was impudent to his teachers. One day, a teacher sent him on an errand requiring him to go some distance away from the school. He was given no specific instructions, but was left to his own resources. This teacher had discovered that the boy came from a well-to-do family where his every move was managed by an oversolicitous mother. He had no freedom of action or thought. The boy completed his task and returned with pride to his room. Soon he became the responsible errand boy. "If you want something done, ask Jimmie." At the same time, his behavior in general became more praiseworthy. He was an individual; his pre-eminence in one field, at least, was established.

Man's chief concern seems to be with the satisfaction of his own requirements. This seems especially apparent when we examine the behavior of very young children. To the child, all things are "mine," and we say that the child is "naturally selfish." Self-interest is less concealed in the child because he has not yet learned to mask it with the more acceptable behavior of later life. Nevertheless, we must not assume that the self-centered outlook has disappeared in the adult simply because it is well covered up. An extreme point of view would interpret all of behavior in terms of the gratification of selfish desires. In this light, everything we do accomplishes some degree of self-gratification. Unless it does attain this end, it is either not done at all or certainly is not repeated.

THE DOCTRINE WHICH STATES THAT ALL BEHAVIOR IS IN THE DIRECTION OF THE INCREASE OF PERSONAL PLEASURE AND THE

AVOIDANCE OF DISPLEASURE IS CALLED "HEDONISM," OR THE "PLEASURE-PAIN PRINCIPLE." The doctrine has received very favorable and widespread attention. There are many, however, who find it hard to believe that voluntary submission to conditions of deprivation, sacrifice, pain, and suffering can be adequately described in terms of this principle.

The hedonistic principle is of interest to us here only because it has been offered as another way of interpreting the behavior that we have listed under the motive of pre-eminence. A somewhat more simplified description of the same behavior is accomplished by treating it as another example of the acquisition of socially acceptable modes of adjustment through the process we have called *learning*. The infant learns very early a whole repertoire of attention-getting responses. He learns that his existence is frequently more pleasant if these responses persist. In the process of becoming an adult, the individual learns more elaborate methods of accomplishing the same ends.

Through competition and the struggle for existence, therefore, we build up two rival motives: We learn that we must conform to the socially acceptable standards; that we cannot appropriate the inventions and discoveries of others. But an opposite attitude is also developing. If our neighbor can do what we cannot do, he has an advantage. If he can dance well, tell a good story, or dress attractively, he gets more attention, and usually attention-getting is important to us. Rivalry thus develops a motive for pre-eminence. We finally strive to conform and at the same time to express our individuality in regard, not only to the essential things in our social life, but also to the things that have no social value. The motive to conform and the motive for pre-eminence are both socially developed motives that have their origin in the basic problem of self-preservation.

Levels of aspiration

Recently, some attention has been given to the possibility of measuring motivation to attain a goal that is stated in terms of standards or levels. It is always dangerous, from the

scientific point of view, to deal with values of this kind. Can the level of aspiration of the workman who sets a high value on good workmanship be compared with the aspiration of a student to become a corporation lawyer? Which is higher depends upon our interpretation in terms of social standards. Psychologically considered, we can only seek a determination of the aspiration in terms of the difficulty of the tasks to be performed.

One method employed is to set tasks of increasing difficulty and then ask the child or adult which he would like to do. He is also asked which he thinks he can do. From such experiments, we may deduce certain tentative conclusions. KNOWLEDGE OF WHAT OTHERS IN THE GROUP CAN DO, OR DESIRE TO DO, MAY HAVE A DIRECT INFLUENCE UPON THE INDIVIDUAL'S LEVEL OF ASPIRATION. The choice usually represents a compromise between the evaluation of one's ability and the desire to achieve a higher level of performance. We do not like to fail in a task, once it is undertaken. Consequently, to set a high standard and fail may injure our own self-esteem. On the other hand, some individuals give up more easily than others. Successful techniques for investigating these relations are important; but at present, we can only surmise what future studies may contribute.

Co-operation and competition

Like conformity and pre-eminence, motives involving co-operation and competition are somewhat contradictory in actual operation, and yet they appear to varying degrees in the same organism. WHICH OF THE TWO WILL APPEAR DOMINANT AT ANY INSTANT DEPENDS ENTIRELY UPON THE CONDITIONS OF THE MOMENT AND THE BACKGROUND OF THE INDIVIDUAL. Team play is a form of behavior that is learned by most youngsters in the everyday give-and-take of their contacts with their contemporaries. The object of many games is to inculcate these habits of "doing one's bit" in the attainment of the goal of the group. Later on, when we discuss personality more in detail, we will note that these attempts to teach generalized habits of fair play and group co-operation through the

use of games and other group activities is not always as successful as it is alleged to be. The mere fact that we can teach a boy to play his part in the attainment of a touchdown for the team does not mean that we have thereby made him a better citizen who will be more willing to carry his share of responsibility in family, community, or government matters.

Of the two activities, co-operation and competition, the latter seems to be the more predominant in our society, although this is not true in some other social groups. Competitive activities are usually not formally taught. It is not necessary that they should be. Their acquisition seems to be the outgrowth of very many person-to-person relationships. As a matter of fact, it is somewhat remarkable that certain group activities can be successfully executed at all, so ingrained are the habits of competition in our society. Many coaches of athletic teams complain of this difficulty in their attempts to get players over their habits of individualized rivalry. IN SPITE OF APPARENT SUCCESSES, IT IS TRUE THAT CO-OPERATION IS MOST EFFECTIVE WHEN THE REWARDS ATTAINED ARE AS INDIVIDUALIZED AS POSSIBLE.

The relative importance of competition and co-operation has been subjected to experimental verification, both with animals and children. It has been demonstrated that monkeys and young chimpanzees can learn to co-operate in getting food. Two chimpanzees, for example, will co-operate in pulling a box to the cage that is too heavy for either alone, in order for each to get a reward for himself.[2] The experiment with children measured their speed in adding under several conditions: competing with other members of the class; co-operating with the rest of the pupils in their room, in competition with other rooms of the same grade; co-operating with another pupil against other pairs of pupils; and so forth. It was found that the average scores were highest in those situations in which competition was individualized. Co-operation proved to be a factor of less importance as the co-operative enterprise

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[2] Crawford, M. P., *The Cooperative Solving of Problems by Young Chimpanzees,* Comparative Psychology Monographs, No. 68 (1937), Vol. XIV.

became more remote from the individual—that is, a pupil co-operated best with a single individual or with a small group of his own choosing than he did with the whole class.[3]

The more or less universal character of competition as a characteristic of our behavior is not always apparent to the college student. With the exception of the rivalry associated with the affairs common to adolescent development, the college student has had little to do with the competitions upon which most of his life after college will be based. Mother and Dad have fought most of the battles as worthy representatives of sons and daughters. The apparent lack of rivalry in the affairs of the student is due to the fact that much of his activity goes under other names and the practice of masking personal competition with other more palatable forms of play. The very widely used "curve system" of grading, however, is a prime example of competition at the college level. This system works on the simple principle that a certain percentage of students with high scores will receive the highest letter grade; another percentage of those with the lowest scores will receive a letter grade designating failure. This designation of "failure" does not mean that a student knows nothing about the content of the course in which he takes the examination. It means simply that he knew less than, say, ninety per cent of those *with whom he competed.* And yet, contrast with this realistic attitude, the attitude of many students toward such examinations: Besides getting as much help as they possibly can in the form of "cribs" and other devices, it is common practice for students to give away to other students information that they have taken the trouble to learn. Everyone is out to "fool the professor," and the competitive angle of the situation escapes notice entirely.

Upon graduation, alumni are continually being rudely awakened to the fact that business and professional life is not run according to these easygoing rules. Their competitors are out for everything they can get and will give nothing in return. Instead of giving things away so liberally, the student soon

[3] Maller, J. B., *Cooperation and Competition. An Experimental Study of Motivation,* Teachers College Contributions to Education No. 384 (1929).

learns to keep what he knows to himself until he is assured that he alone will get credit for it, either in the form of recognition or "a slight fee." Whether such a hard-boiled, back-biting, cut-throat form of rivalry is desirable or not is entirely beside the point. The fact is that it is the kind of life the student may expect to encounter, and it can be argued that many of his college experiences do little to prepare him for it.

On the other hand, many college activities are highly competitive and afford the student an excellent opportunity to learn how much punishment he can stand. Some students are amazed to learn how much of the punishment for their mistakes has been absorbed by thoughtful and indulgent parents. The away-from-home aspect of the college experience may give the student his first taste of condemnation for error. One of the hardest things for a student to learn to do is to abide by the consequences of his own decisions. When he decides to put off his study because of other things he would like to do, it is a bitter pill to swallow to learn that he is behind in his work. The commonly accepted practice when such a condition develops is to present some form of excuse—genuine or manufactured. The professor who does not accept these transparent rationalizations is not a very popular person. And yet, it may be argued that the teacher who holds a student to the consequences of his decisions is actually doing more to prepare that student for life after college than those who allow the student to drift along. If these principles seem to apply only to men because of the illustrations used, we should remember that they also are operative in the activities of women students. Possibly the only difference lies in a somewhat greater emphasis upon social activities in the case of women.

Applications of the Principles of Motivation

Production with and without incentive

We might expect that when children have learned, under the motivation of some type of reward, to perform a task,

their performance would remain high after the reward has been discontinued. An experiment with fifth-grade children demonstrates that this is not necessarily the case.[4] Fifth-grade school children—nineteen boys and sixteen girls—were given ten-minute practice periods in multiplication three days a week for seven weeks, in a room adjoining the classroom and under the same conditions in the preliminary and control periods. The preliminary periods were merely for acquainting them with the task to be performed. Table IV gives the

TABLE IV

THE EFFECTS UPON MULTIPLICATION OF DIFFERENT DEGREES OF INCENTIVE

Day	*Condition of Experiment*	*Average Score*
1	Preliminary	19.9
2	Preliminary	22.3
3	Control	24.3
4	Control	23.4
5	Control	23.5
6	Control	23.2
7	Ambiguous	....
8	Chocolate-candy incentive (increasing requirement)	27.7
9	Chocolate-candy incentive (increasing requirement)	31.4
10	Chocolate-candy incentive (increasing requirement)	32.2
11	Chocolate-candy incentive (increasing requirement)	32.4
12	Control	23.9
13	Control	22.8
14	Ambiguous	....
15	Chocolate-candy incentive (decreasing requirement)	35.8
16	Chocolate-candy incentive (decreasing requirement)	35.1
17	Chocolate-candy incentive (decreasing requirement)	34.4
18	Control	23.1
19	Control	24.2
20	Rivalry incentive	34.6
21	Many incentives	38.9

results. During the first two preliminary periods, the score was approximately twenty and twenty-two problems solved, respectively. From the third to sixth day was a control period, with an average score of a little less than twenty-four problems solved. Conditions for the seventh day were ambig-

[4] Leuba, C. J., "A Preliminary Experiment to Quantify an Incentive and Its Effects," in *Journal of Abnormal and Social Psychology* (1930), Vol. XXV, 275–288.

uous, and no score is given. On the eighth to eleventh days a five-cent box of chocolates was offered as a reward if a certain standard in performance was reached. This standard was set in accordance with each child's ability and gradually increased from day to day. On the twelfth and thirteenth days no reward was offered; the only motivation was to do the best they could. It will be observed, again, that the score fell to approximately the same level as in the control period. The conditions for the fourteenth day were again ambiguous. On the fifteenth to seventeenth days, the chocolate reward was again offered, but the standard of attainment in order to receive the prize was decreased. The eighteenth and nineteenth days were control days, and again show a drop in the score to the level of previous control days. On the twentieth day, each child was in competition with all of the other children; and on the twenty-first day, all the incentives of rivalry, praise, standard of work necessary, and the candy prize were used.

The significant feature of these results was that, although there was an increase from the first days to the last, when some incentive was used, the control periods always showed a drop to the original standard of performance. The children do not necessarily do their best at any time—that is, they do not maintain the high achievement of which they are capable. They fall into a compromise somewhat below their capabilities. It is quite probable that this is characteristic of most individuals. IN FACT, WE OFTEN DISCOVER WITH SURPRISE THAT, UNDER CERTAIN MOTIVATING CONDITIONS, WE ARE CAPABLE OF DOING MANY THINGS WE HAD NOT PREVIOUSLY DREAMED WE COULD DO.

The influence of expectation

In laboratory experiments—and presumably the same thing is true in daily life—the individual's output is often influenced by what he believes is his production rate or by what he is led by the experimenter to expect under certain circumstances. For example, there have been numerous experiments to study the effects of fatigue or of a distracting stimulus. Naturally, one would expect that a work period sufficient to produce a

feeling of fatigue would be followed by a decrement in the output. Likewise, we would expect the best work under conditions of quiet or uniform surroundings. Students often complain that the noise in the library or in the house where they live interferes with getting their work done. Experiments in the laboratory have often shown the reverse effect in both these cases. The subjects of the experiment may be required to add columns of figures under quiet conditions. This is followed by a period of adding while a loud speaker blares at intervals. The next day the experiment is repeated, with the quiet and noise periods reversed. Repeated tests of this kind show that some subjects, on the average, do better in the "distraction" or noise periods than in the quiet periods.

Several explanations of these results have been proposed, but one investigator [5] set out to test the hypothesis that the *set,* or *expectation,* of the subjects influenced their results. One group of subjects was shown a graph of two curves based on earlier experiments and told that one curve represented the number of multiplications performed in ten daily periods working under quiet conditions. The other, lower, curve represented the performance under noise conditions. The subjects in the multiplication experiments, therefore, had performed more multiplications when working in quiet. Subjects were told that the present investigation was to determine whether this was also true for addition. For a second group, the results of the falsified multiplication tests were explained as reversed—that is, they were told that the earlier subject had done better under the noise condition. Finally, a third group was shown a graph in which the two curves crossed on the fifth day. It was explained that the subjects did better under quiet conditions at first, but gradually overcame the effects of distraction and, toward the end, did better with the noise.

In each case, the results conformed to the pattern that had been described as occurring in the previous experiment. Some subjects did resist the suggestion, but they were not numerous

[5] Baker, K. H., "Pre-experimental Set in Distraction Experiments," in *Journal of General Psychology* (1937), Vol. XVI, pp. 471–488.

enough nor did they deviate sufficiently from the group to alter the pattern of the curves for either group. In a control group, however, who were merely told that it was desired to discover whether one worked better under one condition or the other, the two curves show no consistent difference under the two conditions.

If we extend our interpretations of these results, WE MAY CONCLUDE THAT THERE ARE MANY FACTORS OTHER THAN THOSE OF THE EXTERNAL CONDITIONS THAT INFLUENCE BEHAVIOR. The importance of this conclusion will be recognized when we come to the discussion of morale.

Motivation in industry

The problem of stimulating employees to their greatest production is one of the important factors in industry. For even though the workers receive proportionate remuneration for their output, there is a great saving to the manufacturer in the cost of overhead. In other words, the cost of the factory and machinery is less in proportion to the output if the efficiency of the worker increases. Numerous devices have been tried in order to motivate the worker to his best achievements. One of the first to be used was the "piece-price" method. In this case, the worker is paid a standard price for each unit produced. Unfortunately, this has at least two defects:

1. The worker feels that, if he produces too much, the piece price will be cut, and he will be left doing more work at the original daily wage.
2. A factor not often realized may be guessed from the experiments with children already described, namely, that the worker is not directly stimulated by the increased wages as he would be by some token that is immediately present or has some social value, in addition to the fundamental problem of earning his living. In other words, the habit of working at a given pace and the habit of expecting money to be spent for his everyday needs may result in the worker falling into a routine of work that is not influenced greatly by the promise of extra remuneration.

One experiment [6] illustrates how some unusual factors may bring about an improvement that even the worker himself did not anticipate.

Typesetters who had been working at their trade up to ten years were studied as to the amount each was doing under standard conditions. The level of the expert typesetters was

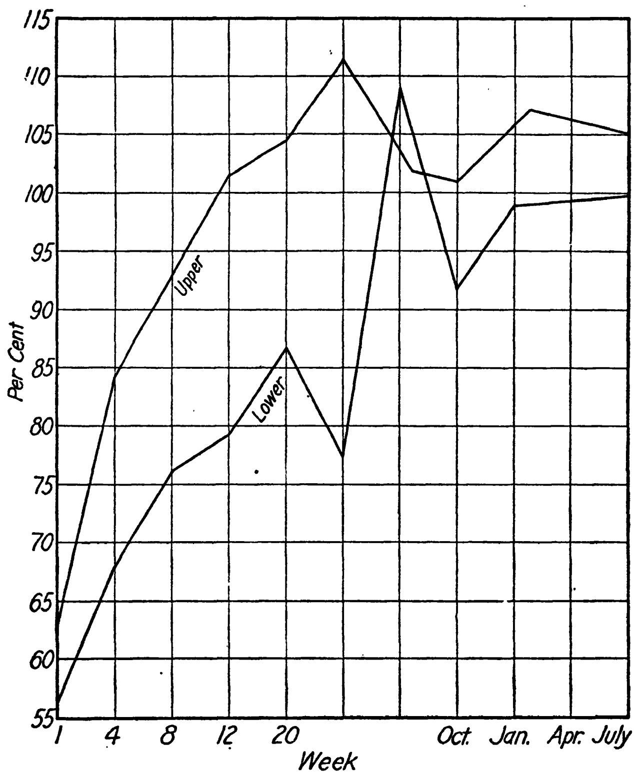

FIGURE 29.—CURVES SHOWING THE IMPROVEMENT OF TWO GROUPS IN SPEED FOR TYPESETTING AFTER SEVERAL YEARS OF EXPERIENCE.

taken as one hundred per cent, and seventy-five per cent of their output was considered standard. Every compositor was paid a flat rate, whether he reached this standard or not. The workers were told that they would be given a bonus whenever they exceeded this standard rate, the amount to depend upon

[6] Kitson, H. D., "A Study of the Output of Workers under a Particular Wage Incentive," in *University Journal of Business* (1922), Vol. I, pp. 54–68.

the number of units above this minimum. The curves in Figure 29 show the results for each four-week period up to twenty weeks, and then for longer periods thereafter. The workers were divided into two groups at the start, on the basis of their skill. It will be seen that, even though the most skilled had been employed in this kind of work for many years, they were able to improve remarkably in the first twenty weeks and remain close to this new level thereafter.

Motivating precision

Just as important to the manufacturer as quantity production is the quality and precision with which the work is done. One paper manufacturer was troubled by complaints from customers that the paper did not conform to the standard set per ream. Finally, the method was introduced of placing on the machine beside the worker every day the expected and measured weights of the paper he produced the preceding day. In other words, the principle of work with knowledge of results was substituted for work without knowledge of results. The number of errors was greatly reduced by this procedure. This experiment shows what we meant in the preceding paragraph when we said that THE WORKER IS BETTER MOTIVATED BY SPECIFIC INCENTIVES THAT ARE APPROPRIATE TO THE TASK TO BE PERFORMED.

An example of the importance of immediacy of the incentive is shown in the case of adolescent girls whose task consisted of threading needles for embroiderers. The manufacturer desired to find some satisfactory method of motivating these girls to increase their output. It was found that their pay envelopes went home to their parents, and therefore there was no immediate reward, except the commendation for doing their part in keeping up the family expenses. Then the management conceived the idea that freedom from the factory routine might be a proper incentive. Consequently, a standard of daily output considerably above that ordinarily attained by the girls was established; and the girls were told that, when the set amount for the day was reached, they could be dismissed. It was found that, under these conditions, the girls

tripled their output. WE MAY CONCLUDE THAT THE MORE IMMEDIATE THE REWARD, THE MORE EFFECTIVE IT WILL BE.[7]

The Problem of Morale

GIVEN A CERTAIN TASK TO BE ACCOMPLISHED BY THE GROUP, "MORALE" PERTAINS TO ALL THE FACTORS IN THE INDIVIDUAL'S LIFE THAT BRING ABOUT A HOPEFUL AND ENERGETIC PARTICIPATION, SO THAT HIS EFFORTS ENHANCE THE EFFECTIVENESS OF THE GROUP IN ACCOMPLISHING THE TASK AT HAND.

Society is not merely competitive. It is co-operative. While the individual is always competing to gain his own ends, the group is a co-operative enterprise, and its success depends upon its *esprit de corps,* class spirit, or faith in its objectives. This depends upon the unity of the group, the confidence of each individual member of the group. Sometimes a team is licked before it goes onto the field; a class fails to measure up to standard because the instructor, or one or two members, inspires a feeling of uncertainty as to the value of the project; an army is defeated because of lack of faith in the cause or lack of confidence in the line of supply at home. Morale is a psychological problem because it pertains to the factors of the individual—his feelings and desires, his hopes and aspirations—in a co-operative venture.

Morale in industry

We may choose industry to furnish good examples of the processes at work in the individual that contribute to the success of a project or that militate against it. Any industry may be considered a co-operative project in which management and labor are both interested, in one way or another. The success of the industry and the welfare of the worker are common interests.

We have seen that financial rewards alone do not necessarily motivate the worker. Also, special techniques must be devised to ensure accuracy or quality of workmanship, such as

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[7] Lee, C. A., "Some Notes on Incentives in Industry," in *Journal of the National Institute of Industrial Psychology* (1932), Vol. VI, pp. 180–183.

immediate acknowledgment of the worker's degree of accuracy. IMMEDIATE REWARDS ARE MORE EFFECTIVE THAN MORE REMOTE REWARDS. Again, there is an increasing realization that some workers resent being considered automatons or machines. They are individuals, with human desires and interests. This is illustrated by the fact that, in one establishment, production was improved by the introduction of systematic interviews. It may not be so much the content of the interview as the fact that the worker feels he is being recognized as a person.

What does the worker want?

Beyond the basic fact that all workers of any kind want to make a living, with varying standards of what this means, workers are interested in many things, some of which seem inconsequential. For example, in one office, it became apparent that there was discontent among the subexecutives. Investigation revealed that some had been furnished four-legged desks, while others were given eight-legged desks. This had resulted in an unrecognized jealousy among those with the "inferior" desks.

To determine more exactly the relative importance of a number of factors in workers' interests, two investigations made use of the method of *paired comparisons*. This consists in pairing each item in a list of items with every other item in the list. The subject is requested to state which he prefers: high pay or a good boss; then a good boss or clean work; and so on, until he has expressed a preference in each pair. These preferences for each item are then totaled. The item that was preferred the greatest number of times is considered the most preferred; the one receiving the next greatest number of preferences is the second preference; and so on. One of these studies[8] used this method with 150 male store clerks and 100 miscellaneous workers. The other[9] investigated 325 female

[8] Chant, S. F. N., "Measuring Factors that Make a Job Interesting," in *Personnel Journal* (1932), Vol. XI, pp. 1–4.

[9] Wyatt, S., and Langdon, J. N., *Fatigue and Boredom in Repetitive Work*, Industrial Health Research Board Report No. 77 (1937), pp. 43–36.

factory operatives in England, with 10 of the original 12 items used in the first study.

The results of these investigations are given in Table V. The items are here arranged in the order of preference of the department-store workers. It will be seen that the miscellaneous group of workers do not deviate greatly from the department-store workers, while there are some marked shifts in the order of preferences of the women workers. In each case,

TABLE V

THE RELATIVE IMPORTANCE OF FACTORS OF EMPLOYMENT

Factors	*325 Women*	*150 Department-store Clerks*	*100 Miscellaneous Workers*
Opportunity for advancement	5	1	1
Steady work	1	2	2
Opportunity to use their ideas	7	3	3
Opportunity to learn a job	8	4	3
Good boss	4	5	5
High pay	6	6	7
Opportunity to be of public service		7	5
Good working companions	3	8	8
Comfortable working conditions	2	9	9
Good hours	9	10	11
Clean work		11	10
Easy work	10	12	12

"high pay" is near the middle. "Opportunity for advancement," or hopefulness, and "steady work," or security, are more important than present pay or an easy or comfortable job.

We cannot conclude from these studies that the same results would be found in every place employing workers. In some cases, working hours may be unsatisfactory; or the foreman may not be able to inspire confidence as the leader. Fear of profiteering, that the worker is not getting his fair share, may produce low morale. Not all strikes, however, are due to demand for wage increases, even when they seem to be so. It should be remembered that some of the things wanted most by the employee are the hardest for the employer to furnish. "Steady work," for instance, is a result of market conditions, over which the employer has no control.

Monotony

We read frequently that the modern method of splitting up tasks into small units and the introduction of the conveyor in mass production has brought about a new problem of monotony. A number of attempts have been made to select workers on the basis of their resistance to monotony. It is found that some can perform a simple task time after time, while others "break under the strain." It is not clear, however, just what constitutes monotonous work. There has always been monotonous work. Someone has said that "doubtless the neolithic artisan who chipped arrowheads found his work monotonous." Many intellectual tasks involve long hours of routine calculation or microscopic examination. The interest in the outcome frees the worker from the monotony. When it is impossible to arouse interest, or if the worker is not suited to the task, other steps must be taken. Some employers have found that a certain amount of rotation among several part jobs has been a successful compromise between the waste resulting from monotony and that resulting from lack of specialization.

Praise and reproof

There are two extreme schools of thought regarding the proper attitude that should be taken toward the proper motivation of a child. One group holds that punishment for failures is more effective than rewards for success. Some even go so far as to declare the good behavior of a child should be taken for granted. At the other extreme are those who believe reward, even for poor work, will produce better results than any form of punishment.

To test these hypotheses,[10] school children in the third, fifth, and eighth grades were given standard tests for each grade. Then, a week later, they were divided into three groups and again tested, but this time under three different conditions. The first group, the control group, was simply given the test,

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[10] Hurlock, Elizabeth B., *The Value of Praise and Reproof as Incentives for Children,* Archives of Psychology No. 71 (1924).

with no comments. The second group was told of its superior performance the week before. This was not true; these children had been selected as representative of the whole group and were only equal to the control group. However, they were praised and encouraged to do their best to improve their previous score. The third group was treated like the praised group, except that it was reproved for its inferior accomplishment.

The results of the experiment justify the following conclusions:

1. Praise and reproof were both effective in raising the scores of the older children, but had little effect on the younger children.
2. Boys responded slightly more to both praise and reproof than did girls of the same age.
3. Reproof had its greatest effect upon children rated by their teachers as "superior" in schoolwork, while praise was of greater value for the "average" and "inferior" children.

In general, both praise and reproof may be considered effective incentives for schoolwork; and on the whole, they are of equal value. We cannot say that this is always true. The experiment is defective in one respect. Praise was given *indiscriminately* to one group and reproof *indiscriminately* to the other. One would hesitate to do this in a practical situation. One might choose, instead, to praise only good performance and disregard poor performance, or he might choose to neglect good and reprove poor performance. Most modern educators advocate the former method because, they maintain, it serves to emphasize what is desired, while calling attention to mistakes or generally poor work fixates the errors as well as discourages the child.

Multiple incentives

An attack on the problem of motivation was made by a slightly different method.[11] Thirty-six fifth-grade children were divided into equivalent groups, on the basis of present

[11] Chapman, J. C., and Feder, R. B., "The Effects of External Incentives on Improvement," in *Journal of Educational Psychology* (1917), Vol. VIII, pp. 469–474.

ability to add figures. The control group was encouraged to add as many columns as possible in the prescribed period. The motivated group was given these additional incentives:

1. The score of the previous day was marked on each child's sheet.

2. The results of the previous day for all was published, and the curve of the group as a whole was presented graphically on the board.

3. Credits were awarded:

a. In the form of stars, to those in the upper half of the preceding day.

b. In the form of stars, to those in the upper half in improvement.

c. Special prizes, at the end of ten practice periods, to the upper half receiving the most stars.

Here, again, the motivated group (Figure 30A) improved markedly, while the control group, which was merely told to do its best, lost ground slightly. The fact that both groups

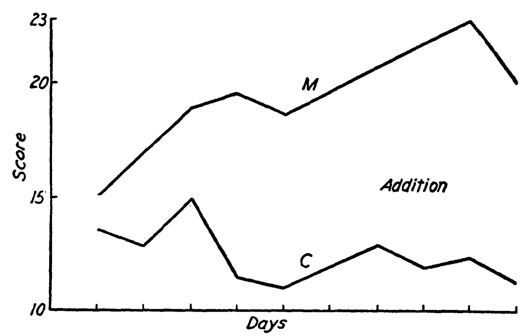

FIGURE 30A.—CURVES SHOWING THE EFFECT OF INCENTIVES ON THE SPEED OF ADDING.

failed to do as well on the last day as they did on the ninth indicates that some other factor, not accounted for, was operative on the tenth day. In fact, the variations from day to day in such studies all go to show that THE FACTORS MOTIVATING BEHAVIOR ARE NEVER CONSTANT. On some days, you say that you "don't feel like working." The goal or incentive ceases to be as important at one time as at another.

Increasing incentives

The value of a reward is relative. The child who receives an allowance of twenty-five cents a week "for being a good boy" is rich. But soon he is clamoring for fifty cents. What is the effect of increasing the reward over that of a constant amount throughout the experiment? This was tried with a group of British schoolgirls.[12] Each day, for forty-six days, these girls—nine to thirteen years old—added figures as rapidly as possible. Each girl was paid a small amount each week; and furthermore, three prizes—one shilling, ninepence, and sixpence—were offered to the three who added the greatest amount. Thereafter, each girl was awarded a prize every

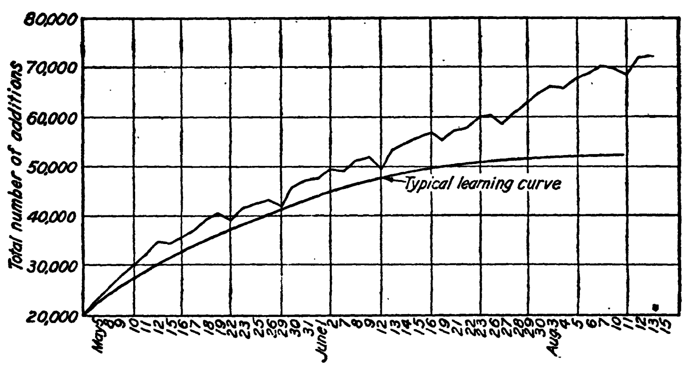

FIGURE 30B.—CURVES SHOWING THE EFFECT OF REPEATEDLY INCREASING THE VALUE OF THE REWARD.

time she exceeded her previous best record. These prizes were increased each week: One penny was given for the first week; one-and-a-half-pence the second week; twopence the third week, and so on. In addition to these rewards, the girls kept individual progress records and had knowledge of the results of the others in the group.

Usually, the practice of a function, such as adding, is accompanied by an increase in proficiency—rapidly at first, and then less and less rapidly, until no further increase is observed. We say, then, that the limit of the practice effect has been

[12] Flügel, J. C., *Practice, Fatigue, and Oscillations,* British Journal of Psychology Monograph Supplement No. 13 (1938), Vol. IV.

reached. In this experiment, however, the rate of improvement at the end of 46 days was as great as at any time after the first week. A "typical" learning curve has been inserted in the graph of Figure 30B to emphasize the difference in these results. On the basis of these results, it is reasonable to infer that IT IS BETTER TO OFFER A SMALL TOKEN FOR SUCCESS AND INCREASE IT FREQUENTLY BY SMALL INCREMENTS THAN TO START WITH A LARGER AMOUNT THAT CANNOT BE INCREASED. A practical instance of this is the manager who offers new employees $100 a month but increases the amount every 3 months, as compared with the employer who pays $200 but offers no increases for over a year or two. It is found that the former has less difficulty with new employees.

Summary

The problem of motivation has baffled men for ages. The answers to the questions that have arisen have proved unsatisfactory because they have attempted to postulate an innate, basic urge common to all men under all conditions. Apparently, no such universal desires exist. A more effective way to attack the problem has been that of investigating each situation in which the question of motive has arisen, and to describe behavior in terms of the conditions surrounding that situation and the background of the individuals involved.

Such investigations have unearthed motives of conformity, pre-eminence, co-operation, competition, and others. The fact that men differ widely in the degree to which they exhibit behavior associated with these motives, and the fact that contradictory motives may be expressed by the same individual, only emphasizes the highly individualized character of this aspect of behavior.

Some basic principles of motivation have been isolated and successfully applied. These include: (1) the importance of the immediacy of the reward; (2) the superiority of praise over reproof; (3) the importance of tangible rewards; and (4) the value of increasing the amount of the reward.

6

Physiological Basis of Motives

The Origin of Motives

When we talk about "attention-getting devices," "socially acceptable" methods of goal achievement, and other aspects of the problem of human motivation, it may occur to you that, as yet, we have laid no ground plan of the stimulus-response relationship that we have said exists in all of behavior. We have started in the middle of the story by describing the observable end effects before taking up their origin. With this introduction, it will be a little easier, however, for you to trace backward than to start with the origin and trace forward.

In passing, we might note that a considerable amount of the task of tracing the origin of motives has been done with animals below the human level. As we go on, you will see why this has been necessary. Many of the experiments that must be done require the control of variables over which we have no command at the human level. Try not to let the emphasis upon work with lower animals at this point confuse you. You will see that what we are after is the discovery of general principles; that these principles are operative in all living things; that the difference here between man and the lower animals is again a quantitative one.

Man is not only social; he is also a biological organism. Fundamentally, he is like all other animals. He must have food; he must drink, sleep, and adjust to temperature changes. He must also reproduce his kind, although this is not so im-

portant to his own self-preservation. Furthermore, like other animals, he possesses receptors that bring him into contact with his world, and he reacts to stimulation of these receptors.

Persistent stimuli (drives)

If you are pricked by a pin, you make some sort of response. This response usually frees you from the pricking pin. If it does not, you continue to respond. You may have noticed that, in a crowded lecture room, as the room gets too warm, the audience becomes restless. Children get restless toward the end of the school period because they are "tired of sitting still." After eating a satisfactory meal, you are likely to get sleepy; but when you were hungry, you could not sit still. There are a great variety of conditions that excite receptors and continue to do so until the physiological condition aroused by their stimulation is relieved. IT IS CUSTOMARY TO CALL THESE PERSISTING STIMULI "DRIVES."

THE RESPONSE THAT RELIEVES THE CONDITION PRODUCED BY THE PERSISTING STIMULUS IS CALLED THE "CONSUMMATORY RESPONSE."

Drives and motives

In our everyday conversations, and frequently in more technical psychological descriptions, the two terms *drive* and *motive* are used interchangeably. We speak of the "drive" to get on in the world and the "motive" to succeed. There is no need to quibble over terms, provided we know how they are defined. WE HAVE DEFINED "DRIVE" AS ANY PERSISTENT STIMULUS THAT RESULTS IN SOME SORT OF ACTIVITY UNTIL THE STIMULUS CEASES TO BE EFFECTIVE. "MOTIVE" IS THE TERM APPLIED TO BEHAVIOR WHICH, THROUGH PRACTICE, HAS BECOME ASSOCIATED WITH THE RELEASE OF THE TENSION PRODUCED BY THE DRIVE. When an animal has learned that, when hungry, if he presses a trigger he will get food, we say that he is "motivated" to press the trigger when hungry. Not all motives are so simply related to drives. You are motivated at one time to go to lunch because you are hungry. This is simple enough. But at another time, you are motivated to go to lunch because the clock strikes twelve. Evidently, there is a

variety of stimuli operative in this case: You are in the habit of eating at twelve; if you don't, you'll be hungry later; "everybody" eats at twelve; and so forth.

Experimental Studies of Drives

Hunger

It has been shown [1] that the condition known as *hunger* is associated with rhythmic contractions of the empty stomach. To demonstrate this fact, the subject swallowed a small balloon attached to a rubber tube. The balloon was then inflated

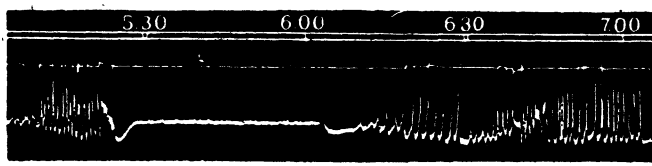

FIGURE 31.—CORRESPONDENCE BETWEEN THE PERIODS OF HUNGER CONTRACTIONS AND THE PERIODS OF OVERT BODILY MOVEMENTS. A sample kymograph record. Upper line: Time indicated by half-hour breaks. Middle line: Bodily movements indicated by vertical departures from the horizontal level. Lower line: Stomach contractions shown as tonus in the long level tracing, and as hunger contractions in the pronounced vertical records. (*Wada.*)

until it filled the stomach but did not produce any noticeable pressure on the stomach walls. The free end of the tube was then attached to a tambour, which in turn was attached to a recorder writing upon a revolving drum. By this means, it was found that, when the subject reported "sensations of hunger," the apparatus also recorded contractions of the stomach.

It has also been shown,[2] not only that these "hunger contractions" coincide with the subject's report of hunger pangs, but that there is a direct relation between the periods of contraction and the general explicit bodily activities (Figure 31). One subject, after being thoroughly accustomed to swallowing the balloon and tube, slept in the laboratory during the ex-

[1] Cannon, W. B., and Washburn, A. L., "An Explanation of Hunger," in *American Journal of Physiology* (1912), 29, pp. 441–454.

[2] Wada, Tomi, *Hunger in Relation to Activity*, Archives of Psychology No. 57 (1922).

periment. He had had dinner at 6:00 P.M., and the experiment started at 10:45 that evening. At 12:15, some body movements were recorded. From then on until morning, most of the body movements occurred at the height of the stomach contractions. For two other subjects who lay on a couch and read all day, numerous body movements were shown at contraction periods, while none occurred during the quiescent cycles.

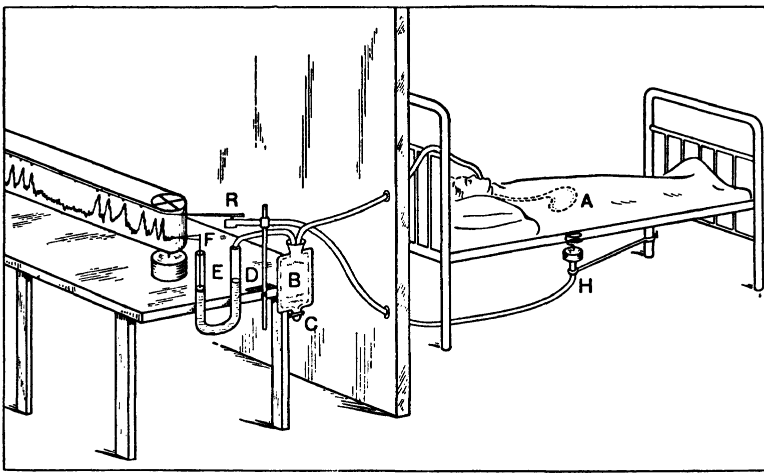

FIGURE 32.—THE RECORDING OF STOMACH CONTRACTIONS AND BODY MOVEMENTS. An inflated balloon in the stomach (*A*) is connected with the recording instrument (*E*) which registers the contractions of the stomach. The tambour (*H*), connected by a coil spring to the mattress and by a rubber tube to the recorder (*R*), registers slight movement of the body.

In another experiment,[3] the degree of activity of rats was recorded 6, 12, and 21 hours after feeding. Six hours after one group of rats had eaten all they would eat, they were placed in revolving cages of the squirrel-cage variety. Recorders attached to these cages counted the number of revolutions. The same procedure was followed for the other two groups. The group that had been without food for only 6 hours averaged 143.1 revolutions in the test period; those

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[3] Ligon, E. M., *A Comparative Study of Certain Incentives in the Learning of the White Rat,* Comparative Psychology Monographs No. 6 (1929), pp. 1–95.

that had not been fed for 12 hours averaged 121.8 revolutions; and the third group, after 21 hours, averaged 219.7 revolutions.

Immediately after the revolving-cage test, these same groups were each day confronted with the task of learning to run through a maze with several choice points. Food was the reward placed at the end of the maze. It was assumed that the goal would be more important the longer the time since the rat had been fed, and that therefore the rat would run faster on each trial. The curves of Figure 33 show the results.

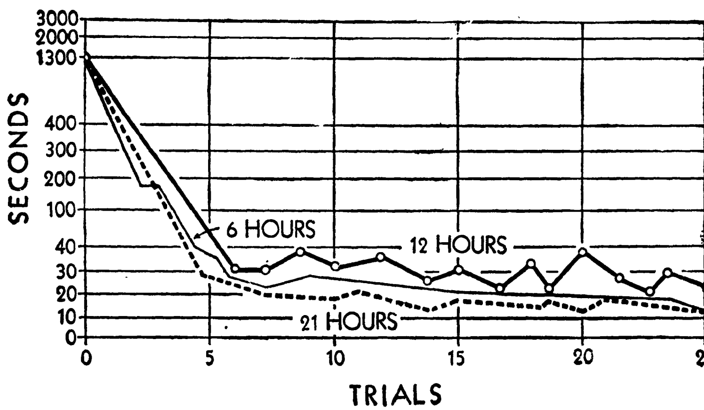

FIGURE 33.—CURVES OF RATES IN LEARNING A MAZE FOR RATS RUNNING 6, 12, AND 21 HOURS AFTER FEEDING. (*Adapted from Ligon, p. 30.*)

These are typical learning curves. The animal generally makes greater improvement during the first few trials. Evidently, the rats of all three groups increased their speed to nearly the maximum by the fifth or sixth trial.

The data from both the activity cage and maze learning exhibit a reversal of the sixth- and twelfth-hour groups that we should not expect if activity were proportional to the hunger drive. The investigator explains this discrepancy by taking into account that another drive may also be operative six hours after feeding: The rat is not particularly hungry at this period, but he has recovered from his lethargy and is stimulated by a "feeling of well-being." This general stimulus,

plus the slight hunger stimulus, create a drive that is greater than twelve hours' hunger. The greatest activity as measured by these tests occurs after twenty-one hours of fasting, as we would expect on the basis of our original assumption. These data lead to two conclusions: (1) activity at any moment may be the result of the simultaneous operation of several drives; and (2) the activity produced by a specific drive appears to reach a maximum at a fairly well-defined time.

Another method of studying the hunger drive is to determine how much resistance the animal will overcome in order

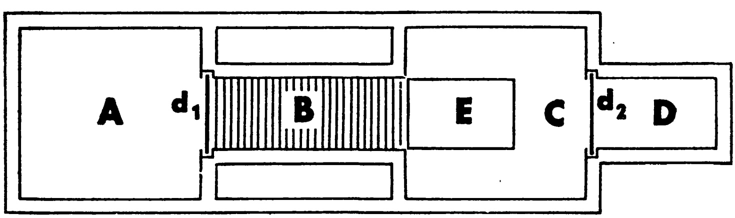

FIGURE 34.—OBSTRUCTION BOX USED IN MEASURING THE STRENGTH OF DRIVES. (*After Warden.*)

to reach the goal—food. In the case of a man, we might ask: "How much wood will he chop in order to get a meal?" Or, to put it another way, "How hungry must he be before he will cut a cord of wood to receive food?" Figure 34 represents the ground plan of an obstruction box used with rats.

The hungry rat is placed in *D*. When the door, d_2, is opened, he may wander about until he discovers the food at *A*. This is repeated until the rat has learned to go to *A* for food. Then the electric grill, *B*, is charged; and the rat, after a given fasting period, is released from *D*. The number of times he approaches the grill and the number of times he crosses the grill in the period allowed are taken as the score or strength of the drive. When the rat had fasted for two to four days, the number of crossings to food was eighteen in twenty minutes on the average. As the fasts were prolonged beyond four days, the number of crossings decreased. This may mean that the stomach contractions have ceased, thus removing the stimulus, or that the energy of the animal is being depleted.

Thirst

When the water in the tissues is below normal, the salivary glands decrease their secretion, resulting in a dryness of the membranes of the mouth. *Thirst* is therefore a result of a tissue need; but it is expressed by the stimulus of drying and stiffening of membranes in which receptors reside. Water applied to these membranes removes the thirst temporarily. Likewise, acid applied to the mouth removes the thirst for a short time, by stimulating the glands to secrete. But neither of these methods removes the tissue need for water.

As measured by the obstruction method, thirst increases during the first twenty-four hours and then slowly decreases. The number of crossings averaged twenty after one day, sixteen after two days, thirteen after four days, seven after six days. These results again may reflect a weakening of the organism, rather than a decrease in thirst stimulation. If we can believe the tales of suffering in the desert, the anguish of thirst is more intense and prolonged than that of hunger.

Sex

The development of the reproductive organs and the increased activity of the glands related to the sex functions are responsible for the general irritability designated as the *sex drive*. While the development of the testes in the male and the ovaries in the female are generally considered the chief causes of the sex drive, other tissue changes affecting the whole organism and resulting in the so-called "secondary sex characteristics" undoubtedly exert an important influence. We say that the boy (or girl) becomes conscious of himself.

The same is true in the case of hunger, except that the hunger drive develops more rapidly and culminates more readily in a specific response. The sex drive develops slowly, and does not develop into a definite pattern of response that is biologically significant until much later in the life of the individual.

The characteristic manifestation of the sex drive in the youth is that he shows general irritability; but he also begins

to react differently to the external stimuli, particularly with reference to individuals of the opposite sex. Whereas in the past he may have treated girls and boys alike, he now begins to observe differences and to behave differently in the presence of girls. The latter may be a disturbing element in his environment; he may react negatively because he finds that he cannot adjust to the new situation. He later has "his girl," because he finds that it is easier to adjust to one girl than to girls in general, and also perhaps because, for the time being, the one is a more dominant social stimulus than the others. He is also frequently overcritical of girls, even at college age. Insignificant details—dress, manners, color of hair, and so forth—are magnified in importance, as against the total personality of the girl. These are merely symptoms of his difficulty of adjustment.

In addition to these visual and more general stimuli resulting from social relations with the opposite sex, bodily contacts bring new stimulations. Embracing and fondling lead to further stimulation and increase of the sex drive. Where a person is ignorant of the meaning and source of these exciting physiological conditions, such exploring alone may be responsible for the completion of the sex response, which is consummatory in that it relieves the tensions. Among certain Australian tribes, the function of sex is not known. Pregnancy is supposed to be the result of touching certain trees where reside spirits which enter the body of the woman.

Hunger versus sex

The question is frequently raised as to whether hunger or sex is the stronger drive. Several investigations with animals indicate that, if the animal is placed in such a position that he may run to food or to the opposite sex, he will choose food —provided he has been deprived of food for a sufficient length of time. It has been found [4] that rats that had been twenty-four hours without food would take the path leading to a receptive female only twenty-three per cent of the time, while

[4] Tsai, Chiao, "The Relative Strength of Sex and Hunger Motives in the Albino Rat," in *Journal of Comparative Psychology* (1925), Vol. V, pp. 407–415.

they chose the food path seventy-seven per cent of the time. It is evident, therefore, that the sex drive is not as dominant as is generally supposed. If this is true with the lower animals, it should be even more true in the case of man, because of the complexity of his behavior, which may render less important any specific physiological condition. In the case of conflicting motives, the situation is complicated by taboos of society, as we shall see when we come to the consideration of conflicts of motives.

Appetite

Many investigators prefer to make a distinction between *hunger* and *appetite*. The former is reserved for the "hunger pangs" resulting from the convulsive contractions of the stomach, while *appetite* is a term applied to the felt need for some specific food. You can probably recall times when you were "dying for some candy" or, after a full meal, you still felt like eating something. On one day, a salad "tastes good" and sweets may be disregarded. Within limits, at least, we are able to balance our diet by choosing from the menu those things that appeal to us.

Numerous experiments with chickens, cattle, and white rats bear out this claim of the preference method of balancing the diet. The expert dietician knows the relative amount of each chemical substance that a white rat, for example, needs to ensure the optimum development. With this information, a mixture is prepared containing these substances: common salt, calcium, carbohydrate, vitamins, and so forth. But if these substances are supplied in separate containers and the rats are allowed to choose "cafeteria style," it is found, not only that the optimum growth is maintained, but that they consume the same proportions of each substance as the expert recommends.[5]

An interesting experiment [6] in cafeteria feeding of infants

[5] Richter, C. P., Holt, L. E., and Barelare, B., "Nutritional Requirements for Normal Growth and Reproduction in Rats Studied by the Self-selection Method," *American Journal of Physiology* (1938), Vol. CXXII, pp. 734–744.

[6] Davis, C. M., "Self Selection of Diet by Newly Weaned Infants," in the *American Journal of Diseases of Children* (1928), Vol. XXXVI, pp. 651–679.

gave similar results. At the time these infants were weaned —at approximately six months—they were presented with a variety of foods and allowed as much of any of them as they wanted, regardless of whether this provided a properly balanced diet. The only restriction was that no rich or harmful foods were available. The result was that the infants often concentrated on one food for several days, then switched to another. In the diet kitchen, these became known as "jags." There were milk jags, sugar jags, cereal jags, and vegetable jags. At the end of a year, the growth charts of these infants could not be distinguished from the charts of the scientifically fed children.

A word of caution is pertinent at this point. We cannot generalize from these data obtained with rats, chicks, and infants that children at all times, or even adults, can safely be relied upon to select a balanced diet. These experimental animals and infants were free of any prejudice regarding foods. The child who has been forced to eat his vegetables when he did not want them, and probably before he needed them, established a dislike that may be stronger than his need. Insistence upon table manners is also associated with food. This is often seen in children who show no appetite at the table but are hungry immediately after leaving it. Adults are even more biased in their food preferences, because many more social influences have affected their training.

These appetites for specific substances are difficult to explain. It is true that the "taste" sensitivity is higher for some of them—for example, salt—when the tissue need is greater. That is, we become more sensitive to the taste of needed salt. However, we do not like a substance simply because we can taste it. Sugar is "sweet" when candy is "sickening." We might assume that we learn that certain substances supply a deficiency. The need stimulates general activity. Eating a particular food removes the persistent stimulus. In time, we learn that this food is quieting, or relieves our restlessness. This learning would take too much time to bring about appropriate responses. Chicks reared in the laboratory until they began to lay had been given no grit or oyster shell. They

had been reared on soft food deficient in calcium. When first presented with oyster shell, they devoured it like starved animals. It is known that the chemical constitution of the tissues influences the reactions to food substances. We may guess, therefore, that the acceptance of a food at one time and its rejection at another is related to chemical changes of the organism; although, as yet, we do not know just what the relation of these chemical changes is. At any rate, **TISSUE NEEDS SET UP SOME CHANGES THAT PRODUCE PERSISTENT STIMULI, WHICH ACT AS DRIVE MECHANISMS UNTIL THE NEEDS ARE SUPPLIED.**

Habit as drive and motive

Another condition of the organism that produces effects very much like those produced by the drive is that of the well-practiced *habit.* Such phrases in our everyday conversation as "force of habit" and "slave of habit" indicate that we are aware of the driving nature of habit. The same stimulus-response relationships exist here as in the more obvious physiological conditions associated with the drives we have described. The exact stimulating conditions are, however, a little harder to isolate. You may have undergone the experience of becoming very restless and irritable in a situation where you are prevented from doing something that you have "always done" under these conditions. This restlessness is very much like that which is produced by such basic conditions as hunger and thirst. The exact mechanism is not as well understood. We may assume, however, that, in the case of a well-practiced habit, a condition has been established in the nerves and muscles such that, under certain environmental conditions, the habit is the most "natural" response. Anything that prevents its occurrence will set up a tension within the organism that is just as disturbing and frequently as pronounced as any of the disturbances produced by the sex drive or by hunger or by any others we have discussed.

This characteristic of habits is sometimes the only basis that may be found for much of motivated human behavior. It is a common experience in families where an older member

has retired from business that this person becomes almost impossible to live with. He wanders aimlessly about the house and yard, unable to do anything for more than a few minutes; he is irritable and unco-operative. Such a condition may persist for some time, until the individual has had an opportunity to develop new habits. The older habits—practiced for periods up to forty or fifty years—of going to work every day and executing a routine of duties can no longer proceed to completion. The effects of the resulting tension are easily discernible. Another instance of the application of the same principle occurs when we must account for the fact that some people go right on performing certain acts even after the drive with which they were originally associated has been adequately removed. Thus, it happens that some people continue to acquire and to hoard long after they have satisfied their own requirements and those of their families as well. Here again, "force of habit" is enough to produce certain well-practiced acts, although they have ceased to fulfill the original objective.

Motives, barriers, and goals

In this chapter, we have attempted to describe some of the physiological conditions that stimulate the individual to specific forms of behavior. We have seen how these physiological conditions produce stimuli that excite the organism to general activity and how this activity brings about a satisfying situation—that is, a response that removes the persistent stimuli. One outcome of these responses is the fact that the individual "learns" that certain responses bring cessation of the persistent stimuli. We say that he becomes *goal-directed.* He has a purpose or knows what he wants; HE IS MOTIVATED WITH REFERENCE TO A PARTICULAR GOAL.

TWO FACTORS ARE IMPORTANT IN GOAL SEEKING: (1) THE CONDITIONS OCCURRING IN THE INDIVIDUAL; AND (2) THOSE REPRESENTED BY THE GOAL ITSELF. If the individual is hungry, he will strive for food—the goal. If he is not hungry, food has no "value." However, we might make the food more tempting in some way. Chicks that have eaten their fill will eat again if the food is moved, or if other chicks begin to eat.

Another factor also comes into the picture: the *barrier* between the individual and the goal. In the obstruction box, the strength of the electric shock is the barrier. The task to be performed is also a barrier. THE "FELT NEED" OR DESIRE, THE BARRIER OR TASK, AND THE REWARD OR GOAL ARE INDEPENDENT ENTITIES, BUT THEY ARE INTRINSICALLY BOUND TOGETHER IN MOTIVATION. A chimpanzee gave up the attempt to reach a banana. Then two bananas were presented, and the chimpanzee again attacked his problem. An instructor announced to his class that he had a job for a student to work on his lawn for which he would pay two dollars for four hours' work. One man volunteered, but just then the bell rang. The next day the proposition was renewed, and no one accepted. Finally, the student admitted that he needed the money more the day before than he did now. The barrier and the reward had remained constant, but the conditions for the individual had changed.

Instincts and drives

Some animals possess relatively few or relatively simple response patterns. Their needs are so few and their responses so limited that we often are inclined to place the behavior in a special category and call it *instinct*. Thus, the chick "instinctively" drinks by sticking his bill in the water and then throwing his head up to let the water run down his throat. On the other hand, the behavior is more accurately described by saying that the chick is stimulated by the "thirst drive"; that random activity brings it in contact with water, which satisfies the drive (relieves the persistent stimulus); and that it thereby learns to satisfy this condition. In other words, it becomes motivated to drink when thirsty. The specific mode of drinking is due to the structure of the chick. This is what we might expect, and it is the type of description desired by the psychologist. But the whole process occurs so suddenly that we do not observe these steps. Likewise, the duckling not only drinks but slips into the water and swims. It possesses the "instinct" to swim, while the chick does not possess this "instinct." The beaver "instinctively" builds a dam,

birds "instinctively" build nests, rabbits "instinctively" run from danger, the oppossum "instinctively" feigns death. THE TERM "INSTINCT" SERVES VERY WELL AS A CLASSIFICATION OF BEHAVIOR, BUT IT DOES NOT DESCRIBE OR EXPLAIN IT. Naming, you will recall, is not describing; and explanation is always in terms of description.

As applied to human behavior, the concept of *instinct* is extremely confusing. In literature, we read that the villain "instinctively" reached for his gun, the hero thwarted in a love affair "instinctively" looked across the valley to the mountains. In neither case is the adverb really descriptive. The villain had established the habit of reaching for a gun; the lover in his perplexity, for reasons unknown, looked at the landscape. The number of instincts attributed to man by earlier psychologists comprise a long list—flight, play, cleanliness, to mention but three. Flight may be by running or by automobile or airplane. Is hunting an "instinct"? Many men like to hunt; and for primitive man, it was necessary. For him, it was the food-getting motive. We have seen how many other drives and motives can be described.

Social extension of basic motives

A MOTIVE THAT IS DIRECTLY THE OUTGROWTH OF ADJUSTMENT TO A PHYSIOLOGICAL CONDITION, AND THEREFORE ESSENTIAL TO THE LIFE OF THE INDIVIDUAL—SUCH AS THE PRIMITIVE FOOD-GETTING MOTIVE—WE MAY CONSIDER BASIC. Many of our motives, however, though traceable ultimately to physiological conditions, have been more directly influenced by the social environment. As an infant, you doubtless squirmed and cried when hungry, and in time learned to seek food. The type of response was largely influenced by those around you. Your physiological conditions had to be satisfied. If you had not had these needs, you would not have reacted satisfactorily to your social surroundings. Yet, your wants now are mainly social. Take the motive for shelter, for example. Primitive man must have shivered in the cold, moving about from place to place until he discovered the advantage of a cave or crude hut. But you are motivated to acquire a house or apartment,

electrically equipped and air-conditioned, in a respectable part of the city. Few of you have ever been really hungry. You are motivated to work for money with which to buy food as a matter of course. The more primitive motives are overshadowed by the customs of the social group.

Money is just a symbol, a token of a reward. This may at first seem strange to you. "Money is everything," you say. Such beliefs—and they are almost universal in our society—help to emphasize the importance of symbols. The fact that you can use money to satisfy many needs—food, clothing, dwelling, automobile, and, even "social position"—easily leads to the substitution of the symbol for the thing demanded. Even the lower animals in laboratory situations have learned to work for tokens they could later exchange for food.

Children soon learn that a smile or other gesture is a symbol of approval. The "best seat" in the schoolroom or the blue star for regular attendance become symbols to the child that he is getting on in the attainment of his goal. These symbols may become the goals themselves. Many students work for grades, forgetting that grades are only symbols for excellence and of no value in themselves unless they can be exchanged for something of real value to the possessor.

To be named chairman of a committee, manager of a department, no matter how small, or executive secretary; or to get into the newspapers as "the notorious criminal"—these are all goals in symbolic form. They give the possessor social standing, which in turn gives him what he originally was striving for: satisfaction of his physical needs—food, shelter, and so forth.

Many objectives are not attainable, at least not in the near future. In such cases, symbols become even more important. Thus, a girl may hope to resemble her grandmother when she herself is old. She adopts certain manners, reveres certain things associated with her grandmother. These are symbols of the goal that is out of her reach. The ritual of certain fraternal orders is loaded with symbolisms of the grandeur of courts and knights. Perhaps religion best illustrates the importance of symbols. God. life after death, the attainment of

the perfect life—none of these can be experienced here and now. But symbolic substitutes can represent these concepts; for example, God the Father, the cross, holy communion, and Easter are a few such representations.

A SYMBOL IS A RESPONSE OR OBJECT THAT REPRESENTS SOME OTHER RESPONSE OR OBJECT. Money, tokens, the smile of a sweetheart or of a superior, the bars on an officer's uniform, the word of praise—these represent some other object or response that is desired.

Summary

All our motives could be traced ultimately to a basis in physiological conditions, although it would be difficult to identify the specific conditions in all cases. Internal stimulations represented by such terms as *hunger, thirst, sex, cold,* and *pain* excite the organism to activity. The response that eliminates the stimulating condition becomes associated with this condition. There arises what we may call *goal-seeking activity.* Many social conditions co-operate with the physiological conditions to bring about a modification and increased complexity of human motives, including the substitution of symbolic goals when the real goal cannot be attained.

7

Conflict of Motives

The Decisions We Make

Until now, we have been discussing motives as though they occurred more or less in isolation; as though, for each time and place, there were only one motive. Perhaps you can see why it has been helpful to oversimplify matters a little in order to get a clearer picture of what is happening. We shall not be long in coming to the realization that life is not the simple scheme that has been presented. Instead, each day becomes either a theater in which many motives work together in playing their roles in the drama of our lives or is a prize ring where motives compete, singly or in teams, for supremacy in the direction of our life patterns. The psychologist has addressed himself to both of these situations. He is able to offer suggestions to aid in the development of well-integrated patterns of motives in which conflict will be minimized, and he is able to help in the resolution of those conflicts that do occur.

The more spectacular and more memorable occasions upon which most of us have faced the necessity of dealing with our motives are probably those in which a conflict has occurred. When things are going smoothly, when each of our requirements is satisfied, there is no need for readjustment; and such periods in our life pass unnoticed and are easily forgotten. This does not mean, however, that a well-integrated personality offers no problems. The task of the attainment of this level of adjustment in the first place is no mean consideration.

As we shall see later, when we study personality more in detail, the achievement of the balance we are referring to here is an enormously complicated and difficult task—sometimes impossible to accomplish. For the present, we will concern ourselves with the other phase of the problem, and turn our attention to an analysis and description of what happens when motives "get in each other's way."

Choice

We frequently find ourselves in situations in which two motives of approximately equal strength are opposed, each making a claim for satisfaction at the same time. If we act in accordance with the demands of one, we cannot directly satisfy the other. In such situations, it is conventional for us to say that we "make a choice," that we exercise our "will power." But *choice* and *will* are names. As such, they do not explain the behavior in question; nor do they help very much in describing it. Did you ever stop to think of what you mean when you use the term "will power"? If you should ask your friends what they mean when they use the term, you would probably discover the same vagueness and uncertainty that you found when you asked them to define "mind" or "soul." Such a word, then, has no place in a scientific description of behavior, unless it can be defined so that we all mean the same thing when we use it.

Choice and *will* can be defined. THESE TERMS REFER TO THE FACT THAT, IN A CONFLICT SITUATION, THE DOMINANT MOTIVE ALWAYS PERSISTS. This means simply that what you do in a conflict situation is determined solely by the relative strength of the conflicting motives and the stimulating conditions of the moment. Let us assume a typical case:

Ruth has been invited by John to go to a movie, and by George to go to a dance the same evening. She is debating which invitation to accept. She likes to dance, and she knows that the party will be a gay affair, although a little more hilarious than she feels is in keeping with college ideals. Also, George is an excellent dancer, but not so intelligent as she would wish. On the other hand, the movie is one she has

wanted to see. The leading part is taken by a grand opera star, and as Ruth is very fond of good opera, she does not want to miss this opportunity. Also, John is good company. Ruth is a bit bored by the persistent attentions of George, and to go out with John would be a pleasant relief. Nevertheless, she has been working hard, and would not the relaxation and gayety of the party do her more good than the quiet, intellectual atmosphere that she would maintain about her if she went to the movie with John? At this point in her indecision, the telephone rings. It is George, to say that he will call for her at nine o'clock. She says that she will be ready.

Determiners of choice

In this particular instance, we see that there were on each side a number of factors that apparently had equal weight. If either going to a movie with John or to a dance with George were totally offensive to her, there would be no conflict—no choice to be made. But this was not the case. Ruth had developed habits of selecting the cultural advantages, interest in music, and interest in men who were intellectually inclined. On the other hand, the young woman may have been a bit tired of the restraint imposed by study, and may have wanted to break away. She liked dancing, and though she preferred John to the less intelligent George, she knew the latter was a good dancer. She may have chosen to go to the dance on the basis of these factors alone. In that case, we would have to conclude that the dance motive was slightly stronger than the movie motive. But the goal of the one motive was brought a little nearer by the telephone message. The young woman made the choice, but *her choice was determined* by an array of specific factors consisting of *habits, interests,* and the *present condition* of the moment. We see, then, that choices are forced by the circumstances of the individual and his environment. Will is not a "power," but a term that represents the organization of habits and interests that make one motive dominant.

Volition and will

You may be inclined to believe that a decision is an indication of will if you refuse to choose the more immediate goal for the sake of one more remote. Or, you may be confronted with a disagreeable task and with something you desire very much to do. If you choose to do the disagreeable task, you exhibit a strong will. If you yield to the desired activity, you exhibit a weak will. This is a reasonable inference from the standpoint of social standards, but let us examine it in the light of our knowledge of motives:

You are diligently struggling with an assignment in one of your courses when two friends burst in upon you with the announcement that they are going to the basketball game and want you to come along. You resist their arguments and stick to your determination to master a subject that you consider dull and uninteresting in comparison with a basketball game. You say that you refused to do what you wanted to do, and did what you did not want to do. You exercised your will power.

Your statement is quite true, but your will power is just another name for your *dominant motive.* Like the girl with two optional dates, you are confronted with two conflicting motives. Certain habits and developed interests and the immediate situation, including the social stimulus of the two friends and the dullness or difficulty of the work before you, build up a strong "basketball motive." Other habits and interests—a distant goal of scholastic accomplishment, preparation for a profession, a home, and business success—and the social stimulus of a professor, a girl, or your associates in general have built up a strong study motive. *Will power,* then, is a term for the strength of motives which in turn are determined by many factors: physiological tensions, past experiences, and social contacts.

Deliberation and set

In the first example, there was indication that the young lady was deliberating before she made her choice. The factors

on both sides were being weighed; although in the end, the choice was practically made for her. In the second case, you may have argued the advantages and disadvantages of studying or going to the game, but the chances are that you had already made your choice. You were *set* to study, and you resisted anything that would disturb that decision. A college sophomore related a very similar situation that occurred in his own experience:

Upon graduation from high school, he spent the summer in camp with a group of high-school graduates from different parts of the country. They were all serious youngsters, and they talked a great deal about their plans for entering one college or another in the fall. This young man began to consider the possibilities from every angle; and in the end, decided to refuse the position that had been offered him, although there were many features in its favor. So far, he has deliberated and made his choice.

After a year in college, he was again offered the position. His friends tried to persuade him to accept. One argument was the question: "What have you got out of your year of college?" That is a hard one for any student to answer concretely, and he could not answer it. Three hours of English, ten hours of zoology? Yes, but what did that mean? Yet, he came back to college and finished the degree. He had "made up his mind" to go to college.

Indecision

Did you ever notice that the most fatiguing experiences are those in which you have failed to reach a decision? When you have once chosen one course of action and actually embarked upon it, you are relieved of a great strain, provided you have become completely divorced from the other project. Balancing one goal against another, continuing to be in doubt, is energy-consuming. Having made your choice, you are relieved. You are no longer laboring under tension.

The man is fortunate who possesses but a single motive and is able to attain a sufficient approach to that goal day by day. Or, since no one is dominated completely by a single motive,

fortunate is the man whose motives are well co-ordinated, fitted together toward a common end. The man whose one occupational interest is to be a good accountant or a sailor is more favorably disposed than the man who would like to go to sea but cannot release himself from his "squirrel cage" in the counting room. The former is well adjusted; the latter is maladjusted so long as this conflict persists. The worker whose motives are in conflict becomes accident-prone. The child who faces similar conflicts may become delinquent. Facing conflicting motives is more than some can endure. This is one reason why, having made a choice, we tend to adhere to it.

Moral values

One thing we must not do in our descriptions of these choice situations is to confuse the psychological description of the behavior with the moral values set up by society or by the individual himself. These two points of view need not be antagonistic. This morning, when the alarm clock rang, a conflict situation developed immediately, unless your habit is to get up promptly. The alternatives of getting up and going to class or of staying in bed and cutting class were presented. Let us suppose that you did get up and go to class. One person might describe your action this way: "You certainly showed a strong will power today to get up and go to classes in such miserable weather." Another person with another set of habits might describe the same action by saying: "You certainly have no will power if you went to class on this miserable morning." Now, when we can apply the adjectives *strong, weak,* or *no* to the same bit of behavior, we are not giving a scientific description of that behavior. IF YOU WANT TO SET UP CERTAIN STANDARDS OF EXCELLENCE, OR IF SOCIETY SETS THEM UP FOR YOU, THEN EVALUATION OF YOUR ACTS MAY BE MADE IN TERMS OF THOSE STANDARDS. BUT "EVALUATION" AND "DESCRIPTION" ARE NOT SYNONYMOUS.

Let us take a specific case of moral values and the underlying motives of behavior. A high-school boy and girl are in love

and inform their parents that they want to marry. The parents "reason" with them and try to point out to them their folly. The boy's father tells how he waited three years until he was self-supporting. The girl's mother pleads her love for the girl: "Mother knows what is best." The children, angered, elope, soon run through their small savings, and are stranded in the big city. The rest is the usual story.

Now, one person will say that it was the parents' fault: "They didn't bring them up right." Another will say that the boy and girl should have respected their parents' judgment. Various other criticisms may also be offered. All these judgments are based upon the standards of behavior that have long been recognized as right or wrong in the community.

But when you ask *why* did they behave as they did, you raise the problem of motives and environmental influences. Both the children and their parents were meeting situations which they never before had coped with in their entirety. What were the motives in this case, and what was the origin of the conflicts resulting from them? The complete analysis, which cannot be attempted here, would lead to an *understanding* of the behavior of both children and parents, rather than to condemnation of either.

Maladjustments as the Result of Conflict

In the preceding cases of the conflict of motives in which one motive finally dominated, we have assumed that the outcome was wholly satisfactory to the individual and would be looked upon as a satisfactory social adjustment from the standpoint of social standards. OFTEN, HOWEVER, WE ACT IN ACCORDANCE WITH ONE MOTIVE WHILE ANOTHER MOTIVE IS STILL INSISTENT AND NOT RECOGNIZED. The fact that a motive has been suppressed or that it has been superseded by a dominant motive does not mean that the suppressed motive ceases to be influential in behavior or that it will never again reappear under other conditions. Presumably, we all possess many unsatisfied motives. We cannot be successful in attaining our main objectives without making some sacrifices.

Daydreaming

One of the most prevalent methods of dealing with motives that cannot be attained is indulgence in phantasy. To what extent this is common is evidenced by an inquiry among college students.[1] A questionnaire was presented to 64 men, principally engineers, and 131 women, all beyond the freshman class. They were asked to report whether they ever daydreamed about the subjects in the list and whether this daydreaming was occasional or frequent. They were also asked to report whether they had indulged in such fantasies in the past month. The percentage reporting such fantasies is given in Table VI.

TABLE VI

DAYDREAMING AMONG A GROUP OF COLLEGE STUDENTS
(After Shaffer)

Subjects of Daydreams	*Percentage Reporting Daydreaming*					
	Occasional		*Frequently*		*Recently*	
	Men	*Women*	*Men*	*Women*	*Men*	*Women*
1. Physical feat	91	60	34	10	30	3
2. Physical attractiveness	89	95	28	73	34	63
3. Mental feat	88	92	47	51	48	42
4. Vocational success	100	98	75	76	81	69
5. Money or possessions	100	97	72	75	69	66
6. Display	78	76	19	21	22	16
7. Saving	89	63	13	11	14	5
8. Grandeur	67	48	17	5	11	7
9. Homage	81	72	16	19	16	13
10. Sexual	97	96	73	76	74	73
11. Death or destruction	39	44	8	2	9	9
12. Martyrdom	70	79	5	21	9	15
13. Worry	92	89	44	57	45	56
14. Other types	63	53	30	21	30	20
15. Repeated dream, any type	89	93	55	51	48	51

All the students reported fantasies of some kind and at some time. Only one man and three women reported no such fantasies in the past month, and their reports may be doubted.

[1] Shaffer, L. E., *Psychology of Adjustment* (New York: Houghton Mifflin Company, 1936), pp. 194–195.

It will be seen by examining the table that there are few differences between the sexes. Men more frequently report fantasies of performing physical feats, while women report more fantasies of being attractive. Sexual fantasies are common to both men and women. Daydreaming of death is relatively infrequent. The "martyr complex" is also relatively infrequent, but is four times as frequent among the women of the group.

Though daydreaming as a substitute method for satisfying desires is quite common, if it becomes the dominant activity, it interferes with the task in hand. Every student finds at times, when studying is difficult, that he frequently goes "woolgathering." Sometimes, however, the trouble can be found to be some other motive that is dominating the situation but that cannot be satisfied or properly dealt with at the time.

Take, for example, the freshman who was failing in her work, although she claimed that she was spending more than the time usually required for study. Any question regarding her problem brought tears. Finally, she confessed that she was unhappy because the other girls had dates. She was unfamiliar with social occasions and could not talk with men, although she desired to be like other girls. When she started to study, she soon began to dream of herself in pretty clothes, going to the movies with a young man, and carrying on an imaginary, animated conversation.

In this particular instance, she was persuaded to try an experiment. She agreed to devote the first fifteen minutes of her study period to daydreaming aloud while looking in a mirror. This often results in breaking a bad habit. Of course, this is only the first step to be taken in helping this girl. We may expect that, unless something is done about the situation that gave rise to the daydreaming in the first place, the habit will return. Perhaps, we should say here—and repeat it again later on—that a very serious mistake is made when we do nothing but treat the symptoms of a conflict such as this. Teaching this girl not to daydream, for instance, does absolutely nothing about the original social maladjustment that caused the daydreaming to begin with. Such a person must be

taken in hand and, with her co-operation, corrections made in her social behavior. This is usually not a difficult task. With a little coaching, both the conflict and the symptoms will disappear.

Unfortunately, an adjustment is not always effected as easily as this. What can we do, for example, in the case of the boy whose daydreaming is the result of financial shortages that prevent him from doing all of the things he would like to do? It is not always possible to eliminate the cause of financial worry. What about the person who is crippled or deaf or blind, or in some other way prevented from attaining some objective that means a great deal to him? We must not jump to the conclusion that adjustments in such cases are impossible. They are most certainly possible, although somewhat more difficult of achievement. The point to be remembered when you are dealing with maladjustments is that it is not the form that the maladjusted behavior takes but the conflict situation itself that is important. When the boy perceives that the conflict between his lack of money and his desire for the things money can buy is interfering with his acquisition of many other important things, he may cease daydreaming. Recently a man stated that he was upset by his failure to secure a promotion. "I want to know," he said, "whether I have reached my limit. If I have, I can forget about promotions and live comfortably." He recognized the fact that the conflict between ambition and reward was the source of his irritation. So, too, the blind or otherwise handicapped person who recognizes his limitations may learn to live satisfactorily within the scope of his abilities.

Inferiority attitude

Most of us feel inferior in some situations in which we would like to excel. IF WE FIND THAT WE ARE INCOMPETENT IN A NUMBER OF SKILLS, WE MAY DEVELOP AN ATTITUDE OF INFERIORITY THAT IS MORE GENERALIZED, PARTICULARLY IN SOCIAL SITUATIONS THAT INVOLVE COMPETITION OR CRITICISM. For example, one young man, although of vigorous constitution, tried several outdoor sports, but never did very well in any of

them. Now he is embarrassed when invited to play any athletic game for recreational purposes. Some students would rather flunk than talk in class. Others avoid social groups as much as possible because they "feel out of place."

Symptoms of inferiority. Often, we find that we have unintentionally offended a person by some joke or innocent remark. We realize that we have "touched a tender spot." A person who has developed an inferiority attitude to any great degree can usually be identified by one or more of the following symptoms: [2]

1. He is likely to be very sensitive to criticism, particularly in the area where he feels inferior.
2. He is prone to develop "ideas of reference"—that is, he suspects others of talking about him or trying to "put him on the spot."
3. He hesitates to join any "sidewalk group" for fear that he is not wanted.
4. He is very responsive to flattery. In fact, he "plays to the gallery" and seeks popularity in every way possible.
5. His reaction to competition is to take it seriously, even in those games where the others take them as sports for pleasure of the contest.
6. Finally, a common trait is a condescending attitude of criticism of others. "John is a pretty good man, but he needs brushing up on his manners."

Rationalizing

When we have a motive that we fail to satisfy, we often try to find some excuse, some socially acceptable reason for our behavior. "I wanted to go to college, but my father died." Plenty of boys have gone to college on their own after their father died. THE PRINCIPAL CHARACTERISTIC IN RATIONALIZING IS THAT IT IS AN ATTEMPT TO MAKE THE CONDUCT APPEAR SENSIBLE BOTH TO ONESELF AND TO OTHERS. The death of a father may have been given as the reason for a change in plans, but often some other cause—such as the love of a girl or unwill-

[2] Bagby, English, *Psychology of Personality* (New York: Henry Holt and Company, 1928), Ch. VIII.

ingness to make the necessary sacrifices—is back of the failure to carry out an original plan.

Rationalizing satisfies the individual that his course of action has been correct, but he has not identified the true causes of his failure and, hence, is not in a position to correct it. Let us take two students as examples, both of whom were students in the psychology laboratory at the same time:

The one student talked freely and easily; never bluffed, blustered, or hesitated. He was soon popular with his associates and professors. If called upon to give an oral report in class, he made the report with apparent ease. Later, he recounted how, as a boy, he had been dominated by his parents. When he came to college, he was incompetent to make decisions for himself and afraid to talk with others. BUT HE REALIZED HIS INCOMPETENCE, AND ATTEMPTED TO DO SOMETHING ABOUT IT. He got himself in every social situation possible. He got into courses where he had to talk. For good or ill, he made his own decisions. There was no rationalizing in this case. He found the answers to his problems.

The other student came from a similar home background and exhibited similar defects. He *rationalized* his situation somewhat as follows: "Too many students talk when they have nothing to say." "Still water runs deep." "I was never given the proper training when I was a child, and now there is nothing I can do about it." These comments, elicited on different occasions, fit together into a "logical" pattern but do not give a true picture of his case. One reason why these rationalizations are so hard to spot in one's own behavior is that their logic appears flawless to the person who makes the rationalization. You will be able to see these false excuses as they crop out in the behavior of others, but you may need someone else to point them out in your own behavior. The illusion of truth that the internal consistency of the excuses creates is the basis for the difficulty in identifying them.

Compensation

Another way to handle thwarted motives is to conceal inadequacies by overindulgence in those activities where there

is an adjustment. You would like to take your girl to the movies, but you have no money. So you invite her to go for a walk, or you spend the evening in conversation. You have compensated for your lack of money by substituting something else. This is a satisfactory adjustment, and you do not feel inferior. The inferiority attitude may lead to a different sort of compensation. The important feature is that the sufferer does not recognize the true state of affairs, or fails to realize the exaggerated emphasis that he is placing on the substituted activity.

A boy who had never been allowed to play with the neighbors' children for fear he would learn something immoral found, when he was about fourteen, that he could not compete successfully in games with other boys of his age; nor could he talk the language of other boys. He therefore sought activities along other lines in which he could surpass his associates. He could play Ping Pong but not baseball; hence, whenever possible, he insisted on the former as the sport of his choice. He also became proficient in foreign languages. He would insist upon talking French until he found that someone else could speak French proficiently. Then he would shift to Italian.[3]

Some students are noisy and "loud-mouthed" in class because they feel inferior to the other students. They attempt to divert attention from their deficiencies. Or, they gain compensation for their frustrated motives by some obscure or remote form of activity. They join protest groups, such as temperance societies, radical political societies, or other minority groups, where they cause more trouble for these organizations.

Identification

An interesting variation of the compensatory adjustment is the mechanism known as *identification.* WHEN FRUSTRATED IN THE ACHIEVEMENT OF A GOAL, AN INDIVIDUAL WILL FREQUENTLY IDENTIFY HIMSELF WITH A PERSON, GROUP, OR OB-

[3] *Ibid.*

JECT THAT IS CAPABLE OF GREATER ACHIEVEMENT THAN HE IS. Usually, the object of the identification has already demonstrated a high level of attainment—that is, the individual who uses this method of adjustment does not risk his success on something of unproved worth.

We must not conclude that this method of resolving a conflict is employed only in severe interferences with achievement. It is a very commonly encountered mechanism; so common, in fact, that it is the person who does not employ this device that is to be considered unusual. Try "listening" to your own conversation sometime, and note the number of times the first-person possessive pronoun occurs. You will find that you talk a great deal about "*my* school," "*my* sorority," "*our* football team," "*my* father," "*my* church," "*my* country." You will find that you use these people and groups of people to bolster up your own shortcomings in conversations where your inadequacies become a little painfully apparent. You have not traveled beyond the borders of this state, but "my father goes to New York about twice a month." Your own attempts to attain social recognition have produced only feeble results, but "my sorority has more women mentioned in *Who's Who* than any other national sorority."

Please note that we are not condemning this mechanism here. We are merely indicating its popularity. The only time when its use might be looked upon with disfavor by the psychologist is when it becomes a substitute for the expenditure of some effort on the part of the person who uses it to get along. Sooner or later, there will come a time when you will be judged in terms of your own achievement. If you have nothing to fall back on but a series of identifications, if there is no product of your own effort, the judgment passed upon you may be somewhat disappointing.

Projection and delusion

Another reaction to a frustrated motive is to perceive in others the weaknesses that the individual feels are his own. The preacher who sets out to live a celibate life but is constantly beset with temptations of the flesh may preach against

the sins of this world and the "baser nature" of man. Hatred and intolerance are symptoms of this *projection* of defeat to other individuals or groups. The young man who is not being promoted in his firm neglects to examine his own qualifications for promotion. Instead, he observes faults in his employer that are really his own.

There is a thin line between projection and the phenomenon of *delusion.* When we have sought relief and protection for our self-esteem by perceiving our weakness in someone else, it is a short step to discover various evidences that the other person is responsible for our failures. "The boss thinks I am a 'red.'" "He wants to get me out because I know too much about him." Students sometimes blame the poor instruction, then develop the belief that the instructor has it in for them.

Summary

In this chapter, we have tried to high-light some of the things that can and do happen when motives get in each other's way to the extent that, if one is satisfied, others remain unsatisfied. We have also outlined the results of frustration in the achievement of some desired goal or reward. When a conflict arises, the resolution is always in the direction of the dominant motive. This dominance may be a matter of habit or may be described in terms of the conditions surrounding the choice situation. The discarded or unsatisfied motive does not thereby become ineffective in behavior, but may give rise to compensations, rationalization, identification, and even delusion.

In preparation for a discussion in a later chapter of these same aspects of behavior, we might point out in passing that the line between the normal and the abnormal in this respect is very thin. The distinction seems to be entirely a matter of degree, and quite arbitrary. As you look in your mirror, you may decide (as who does not?) that, after all, while you may not be exactly handsome, your face has a certain individualistic expression. You do not have the common, everyday type of face that makes up crowds and that people readily forget. There is character in your face, a certain open expression,

honest and straightforward. And yet, as you partially turn your head and frown slightly as you purse your lips and squint your eyes, you "admit" that there is also a certain questioning shrewdness in your expression—the expression of a person who has really "been around." Now we must concede that this is different only in degree from the delusion suffered by some individual who believes that he is a prince or a deity and that his friends are really his subjects or his disciples. Give this matter some thought. We shall return to it later.

8

Feeling and Emotion

Several times during the preceding chapters, we have had occasion to refer to the importance of the adjustment of the organism to its environment. On the basis of the number of times this concept will reappear in this book, you may decide that the sole aim of psychology is the study of the manner in which such an adjustment may be accomplished. This *is* an important reason for the study of psychology; by many it is considered the chief objective. However, life being what it is, the study of adjustment must necessarily entail the study of maladjustment. It may be that we will be better able to understand adjustment through some careful attention to those situations in which the behavior of the organism becomes disorganized and adjustment very difficult, if not impossible. WHEN THE BEHAVIOR OF THE ORGANISM BECOMES DISORGANIZED AS THE RESULT OF THE OCCURRENCE OF A SITUATION FOR WHICH IT HAS NO READY RESPONSE, WE MAY CALL THE DISORGANIZATION "EMOTION." This is the distinguishing feature of emotional behavior: It can and does occur to all degrees, from the mild disturbances we call *feelings* to the gross upsets that are called *emotions*.

Emotional Maturity

If you enter the nursery of any maternity hospital where all newborn infants are fed on schedule, you may find everything quiet and peaceful, with twenty or thirty infants a few

days old all asleep. As the feeding hour approaches, first one, then two or three infants begin to stir, whimper, and finally cry violently. Others begin to waken. If feeding is delayed, the room may be filled with one grand chorus of crying infants. You would recognize that the restlessness and crying were indications of the *hunger drive,* or the "discomfort" of being hungry. The same responses are exhibited if the infant is pricked with a pin or otherwise injured. He manifests no interest in the world unless he is disturbed.

A little later—say, when he is six months old—he handles objects in a crude sort of way, makes sounds manifesting contentment, smiles at members of the family. He is learning more about his world as it affects himself. But his typical responses are fussing and crying when hungry or otherwise thwarted. His physiological needs demand satisfaction, and the only method of satisfying these needs is general activity and crying.

The child of five years presents a different picture—so different, in fact, that we often fail to realize that he is a child and not an adult. If he is hungry, he can use all sorts of devises to secure food. If he wants social participation, he can adjust fairly well to other children, or he can inveigle his adult associates to play with him. But his interests still demand immediate satisfaction. A reward tomorrow does not pacify his demand today. He shouts "for joy" when he is pleased, weeps when he is "sad," and goes into a temper tantrum when he is thwarted.

As the years pass, the child learns how to get what he wants, how to make decisions or choose according to circumstances; he learns to sacrifice some desires in order to attain more important ends. He also is acquiring new interests, love of parents, their welfare as well as his own, friends with whom he is willing to share in order to secure more remote goals, and the satisfaction of seeing others happy. From a crude vegetative animal, he is developing into a human being with sympathies, appreciations, adorations, and a host of other emotionally toned patterns. He is no longer afraid to be left alone, rarely exhibits temper tantrums, and is moderate in his joy and sor-

row. HE IS BECOMING EMOTIONALLY MATURE. ORGANIZED BEHAVIOR IS REPLACING EMOTIONAL OUTBURSTS.

Emotions and Learning

What do we mean when we say that, as the child learns, his emotions become less frequent and less violent, although new emotions unknown to the young child assume importance? If the child weeps or throws a temper tantrum, and the parent rushes to satisfy his demands, the child may continue these emotional outbursts into adult life. On the other hand, if disregarded, he learns socially acceptable methods of satisfying his own demands. A child may fear strangers. If he is dominated by this fear, he may develop "sensitiveness," may be shy in company. But if he is put into situations where he has to talk to strangers and finds no untoward result, his discomfort gradually disappears. A second factor is that we learn certain skills which become substitutes for motives that cannot be directly satisfied. In this way, the unsatisfied motive becomes unimportant. When you first came to college, you may have been homesick. Then you acquired new associates, became adjusted to college life; and now home appeals to you only on special occasions. A third factor is that we learn to endure hardships and become accustomed to certain pleasurable activities. One who has suffered many severe disappointments and hardships becomes calloused to frustrating circumstances, while the one who has had an easy life usually breaks under the first serious frustrating situation.

We also learn to be on our guard, so to speak. We expect some things to occur and are ready for them. A man related the following anecdote at his own expense: Some friends of his were discussing valor. Each suggested what he considered a good example of courage. This man added his bit by stating that he thought risking his life to save his wife would be the most valorous act. Sometime later, a young man who lived in this man's home came in late at night after several weeks' absence. After getting himself a lunch, he decided to wake up the man and his wife for a little chat. As he approached the bed on the side on which the wife was sleeping, she suddenly

awakened and screamed. Instantly, her husband jerked the blankets over his head. Now, it is highly probable that, had his wife awakened him and told him there was a burglar downstairs, he would have acted as he had thought he would.

A classroom experiment

A number of years ago, two students working in the psychology laboratory became interested in a book[1] dealing with the psychology of court procedures and asked permission to try out a little experiment using the whole class as subjects. They then arranged that the instructor should call all the students in the laboratory together in the lecture room and proceed to deliver a lecture. This was done occasionally, and the students endured the lectures rather more than they profited by them. When the lecture was well on the way, the janitor was to come in to sweep. He and the instructor would get into an argument, which would end by the janitor drawing a gun. At this moment, a student outside the open window would fire a gun, and the two students who had planned the experiment would rush to the instructor's assistance. After this episode, the class was to report what had occurred.

At first, all went according to schedule. The instructor started the lecture, to which the students attended passively. In a few minutes, the janitor came in and sprinkled sweeping compound across the floor in front of the lecture platform. The instructor remonstrated, but the janitor went out muttering: "You ain't got no business in here this hour." The class was getting interested and amused. The instructor had some difficulty in picking up the threads of his discourse, and just as he was getting oriented again, the janitor returned with his broom and began to sweep. The instructor came down from behind the long demonstration desk and approached the janitor. The janitor pushed his broom toward the instructor, and the instructor stepped on it and reached for the janitor. The class was now getting restless. As the instructor approached, the janitor stepped back and drew his

[1] Munsterberg, H., *On the Witness Stand* (New York: McClure Company, 1923).

gun, pointing it toward the ceiling, and grinned with amusement. At the same moment, the man outside fired his gun toward the open window.

At this point, the entire schedule broke down. A man closer to the janitor than the two who were supposed to come to the instructor's "rescue" leaped at the janitor, struck him, wrenched the gun out of his hand, and threw it out the window. He still clung to the grinning janitor while the two other students dragged student and janitor into the hall. At the same time, pandemonium had broken loose in the lecture room. One girl was stranded, surrounded by chairs, in the middle of the room, with an expression of horror, staring at the fighters. More women were left in the room than men. One man actually got some distance out of the building before he could be stopped.

When the students were reassembled, they were asked to write a report of just what had occurred. What was the lecturer saying? What did the janitor do and say? Who drew the gun? Who fired the shot? Of course, by this time they all knew the fight had been staged. All gave a surprisingly precise account of the ten-minute lecture. The report of the first little run-in with the janitor was generally quite accurate. But from the time of the instructor's first physical contact with the janitor, the reports began to miss or distort the facts. One report was correct up to the point when the janitor drew the gun. Here it ended abruptly with the statement: "Then I left." Some declared that it was the instructor who drew the gun. One student stated that both the instructor and the janitor had guns, but he could not tell who fired the shot. Another stated that he could not tell who fired the shot but that he saw smoke. This was possible, because the smoke might have come in through the window. However, the window was about ten feet from the battle. The student who attacked the janitor was certain that the janitor fired the shot, because he "had hold of the gun when it went off." The girl who had been unable to escape because she had been caught by the chairs pushed aside in the rush, and who had stood staring at the fight, was no more accurate in the account than

the others. When the man who attacked the janitor was questioned, he stated that the fact that the janitor was grinning led him to believe that the janitor was insane.

The character of events shifted so rapidly from classroom procedures to argument to physical combat that no student was able to perceive the true course of events. Also, this rapid shift left the students with no socially acceptable response. Not one of them behaved as he would like to believe he would in the face of a real danger. They were thrown back upon more *primitive* modes of behavior. You would expect the child to scream or run from a gun battle. One man seemed to be an exception. But his attack was based upon a confusion, as his reports indicated. Another point, discovered later, is interesting: This same student habitually rushed into any emergency. For example, just previous to this episode, a drunken passenger and a railway conductor were on the verge of coming to blows over the passenger's fare when the student jumped up and separated them.

These illustrations all point to the two principles we have discussed so far:

1. Emotion is disorganization of adjustment in the presence of a situation for which there is no immediately adaptive behavior.
2. The disorganization may be avoided by learning, so that it disappears entirely or is considerably minimized.

The Physiology of Emotion

Many words and phrases in all languages indicate that certain physiological processes have received universal recognition as being in some way associated with emotion. The youth has a "sweetheart"; God "hardened the heart" of Pharaoh; the doting father is "tender-hearted"; he is "breathless" with astonishment. We also break out in a "cold sweat of fear"; our "hair stands on end"; our tongue "sticks to the roof of our mouth." Blushing, blanching, loss of appetite, nausea are also some of the well-recognized symptoms of emotion. It will be important, as well as interesting, at this point to

inquire into these physiological processes and the mechanisms by which these reactions are brought about.

The autonomic nervous system

In Chapter II, we very briefly described the character of neurones and their aggregation into what we know as the *spinal cord* and *brain.* Neurones that connect sense organs with the cord and brain (the central system) and neurones that run from the central system to striped, or so-called "voluntary" muscles, are designated as the *peripheral skeletal system.* In addition to these two systems of neurones, there is the *autonomic system,* so called because we have no immediate or direct control over it. It's action is "involuntary." You can move your arm or learn to write, but you cannot dilate or constrict the pupil of the eye or stop blushing, except by some indirect means. The chief function of the autonomic system is to regulate the activity of internal organs, the smooth muscles and glands of the stomach and intestines, the smooth muscles in the walls of blood vessels, the ciliary muscles surrounding the pupil of the eye, sweat glands, salivary glands, and various other glands of digestion and metabolic processes generally.

If you could look into the trunk of a vertebrate—a cat, for example—from which the heart, liver, stomach, and other visceral organs had been removed, you would be able to observe two rows of ganglia, one on either side of the vertebrae. The ganglia of each row are connected by a nerve trunk into a chain running parallel to the spinal cord. Each ganglion is united by communicating branches with the spinal nerves, with various cranial nerves. From these ganglia arise numerous nerve trunks, many of which, in the thoracic and abdominal cavities, form plexuses and ganglia from which, in turn, nerves are given off to the viscera. Two of the most important of these plexuses are the *cardiac plexus* above the heart and the *colliac plexus,* which lies in the abdominal cavity and supplies nerves to the stomach, liver, kidneys, and intestines. Many of these nerves end in the walls of the blood vessels of various organs.

The autonomic system consists of three divisions:

1. The *cranial division* originates in the cranial nerves, from the brain stem, and supplies nerves to the tear glands, ciliary muscle of the eye, the heart, stomach, and intestines.
2. The *thoracico-lumbar*, or "sympathetic," *division*, which originates in the spinal nerves along the greater extent of the spinal cord, supplies nerves to the sweat glands, heart, liver, and other viscera, as well as to the rectal and genital organs.
3. The *sacral division*, at the extremity of the spinal column, supplies the bladder, rectum, and genitals.

The cranial and sacral divisions usually are opposed to the sympathetic division—that is, if the excitation through the cranial or sacral increase activity in a certain gland or muscle group, the influence of the sympathetic is to decrease it. Thus, the nerve impulse through the cranial branch to the heart slows the heart rate, while sympathetic excitation increases the heart rate. The sympathetic excitation decreases or stops digestion, increases secretion of glycogen from the liver, and acts upon the whole circulation system to shift the blood supply from the viscera to the skeletal muscles; while the cranial and sacral divisions tend to produce the opposite effects.

In cases of fear or rage, it has been demonstrated that the heart rate is increased, digestion ceases, there is more sugar in the blood, and the blood pressure in the peripheral arteries is increased. In contentment and a pleasurable attitude, the individual is relaxed, and digestion and heart rate are normal. These observations have led to the hypothesis that pleasure is correlated with cranial and sacral excitation, and that unpleasant emotions arise because of sympathetic excitation. This hypothesis, however, needs supplemental verification.

Glands of internal secretion

Some glands secrete by means of a duct. Thus, the tear glands and sweat glands are duct glands, or glands of external secretion. Some glands are ductless, or glands of internal secretion. The arteries passing through these glands absorb the secretion directly from the glands. The *thyroid* is a famil-

iar ductless gland. Everyone has probably observed that some individuals are very active and easily excitable, while others are extremely slow and not easily aroused to any emotional display. Hyperexcitability of this kind is often due to excessive secretion of the thyroid gland, while lethargy is due to thyroid deficiency.

Aside from generalized excitability or lethargy, specific excitement seems to be related to the *adrenal glands*. These are about the size and shape of a lima bean and are located just above the kidneys. As the arteries pass through these glands, the secretion is absorbed and carried in the blood to other organs. The interesting feature here is that this substance, *adrenin,* seems to have the same effect as excitation through the sympathetic division, and also that sympathetic excitation releases adrenin from these glands. For example, examination with a fluroscope of a cat that was "comfortably fed" and enjoying a quiet rest revealed the rhythmic digestive movements of the stomach and intestines. If at this point the cat was confronted with a barking dog, not only did the cat's hair rise, but the stomach contractions ceased. Blood analysis also revealed an increase in adrenin. Furthermore, if adrenin was injected into the blood, the same symptoms could be observed.

Adrenals as emergency glands. On the basis of these and numerous other investigations, it has been suggested that the adrenals are to be considered as "emergency glands." A situation of danger is a stimulus to vigorous response. This includes communication through the sympathetic division, calling for a temporary cessation of digestion, an increase in energy supply, and a shifting of this supply to the skeletal muscles that meets the emergency. This is the first response. At the same time, the sympathetic division stimulates the adrenal glands, and their secretion soon re-enforces the action already set up by the sympathetic division. It is not difficult to see the practical value of this complicated adjustment. The moment of danger is no time to digest food. It is more important to draw upon the reserve energy supply that the organism has already stored. The sympathetic system provides the mechanism by which this is accomplished through excitation of the adrenals. It is as if the sympathetic system

were the first line of defense in the emergency and the adrenals brought up the re-enforcements.[2] It should be understood, however, that such a comparison is not intended to imply that these emergency mechanisms were provided for the *purpose* of protection. On the contrary, the biologist is convinced that such mechanisms have a *survival value.* If these mechanisms did not exist, or if some other means of meeting emergencies were not possible, the species would be less adaptable to its environment and might even become extinct.

The brain and emotion

When we say that sensory neurones carry nerve impulses into the central system (cord and brain) and motor neurones conduct impulses to muscles and glands, we have not completely described what is taking place. THE CENTRAL NERVOUS SYSTEM IS AN INTEGRATING MECHANISM, AND THE HIGHER WE GO FROM CORD TO BRAIN STEM, TO THALAMUS AND TO THE CORTEX OF THE CEREBRAL HEMISPHERES, THE HIGHER IS THE "AUTHORITY" DISPLAYED. No simple sensory-motor response is limited to sensory and motor neurones alone. Other neurones, and hence other sensory and motor processes in other parts of the organism, influence the process in question. A great deal of this integration takes place in the interconnection in various parts of the brain—for example, in the *medulla, cerebellum,* and *thalamus.* The last-named is a mass of gray matter in the base of the cerebral hemispheres and is in turn regulated by the cortex.

In strong excitement, such as fear or anger, we "lose our head." This was evidently the case in the classroom shooting affair. And for this same reason, we are inclined to be lenient with the man or woman who commits a crime in a fit of anger or yields to temptation in an unusual situation. It has been demonstrated in a number of physiological experiments that the integration at the cortical level fails or becomes partially inadequate; and, as a consequence, a part of the thalamus—the *hypothalamus*—dominates the activity. The excitation

[2] Cannon, W. B., *Bodily Changes in Pain, Hunger, Fear and Rage* (New York: D. Appleton-Century Company, 1923), p. 311.

of the autonomic system and the skeletal responses—such as running, clenching the fists, snarling, and so forth—are the resultants. If this part of the thalamus is destroyed, the symptoms of emotion disappear. FOR THIS REASON, THE HYPOTHALAMUS IS OFTEN CONSIDERED THE BRAIN CENTER OF EMOTION.

Experimental Studies of Emotion

Blood pressure

A simple experiment that demonstrates one of the changes in emotional reactions is the determination of blood pressure in the peripheral arteries under different conditions of stimulation. You may be familiar with the sphygmomanometer used by the physician for diagnosis. This consists of a rubber sleeve or bag, which is wrapped around the upper arm. This sleeve is attached by a rubber tube to a mercury column or a dial, which registers pressure in terms of a column of mercury. The sleeve is first inflated until the pressure upon the artery is sufficient to interrupt circulation. Then the sleeve is partially deflated, until, at the maximum pressure of each pulse, the blood is forced through. This point can be observed by listening with a stethoscope applied over the artery and just below the sleeve.

The height of the mercury column at this point measures the maximum, or *systolic,* pressure that occurs with each heart beat. If the sleeve is further deflated, there will be a point at which the blood escapes continuously beneath the sleeve and the pulse can no longer be heard. This point is taken as the minimum, or *diastolic,* pressure. The difference between systolic and diastolic pressures is the measure of pulse pressure (Figure 35).

If a student is selected from the class and remains quietly seated while the sleeve is adjusted, and a reading is recorded every minute or two, it is usually found that the pulse rate and systolic pressure fall slightly for fifteen or twenty minutes. There is usually little significant change in diastolic pressure noted under these conditions. If, now, the instructor

should say: "I have noticed that Mr. *X* is particularly interested in one student in this class"; or, if the subject is a girl: "Do you have many dates?"—the next reading would very likely show a rise in the systolic pressure of about ten millimeters. The pulse might also increase two to five beats.

When conditions have returned to normal, we might require the subject to exercise—for example, by stepping up on a chair five or six times. Again, we will find that the systolic pres-

FIGURE 35.—A SPHYGMOMANOMETER USED FOR MEASURING BLOOD PRESSURE. In this model, the dial registers the pressure equivalent to a column of mercury. (*Taylor Instrument Co.*)

sure and pulse have risen approximately the same amount as in the former instance. When you walk upstairs, or even walk about the room, these changes take place. But here is a significant fact: Surely, stepping up on a chair involves more physical exertion than the embarrassment of a personal reference. Yet, the slightest emotional response, even when the subject fails to identify it, will often be indicated in blood-pressure readings. The fall in pressure and pulse at the beginning of this experiment may have been due either to rest following the exercise of coming up to the front of the room or to the recovery of emotional response to the situation. Probably, it is due to both.

With some subjects in a classroom experiment of this kind,

the results are not so clear-cut. Some are so emotionally unstable in such a situation that systolic pressure is seldom the same twice in succession. When you believe the subject has at last settled down, you find his pressure has jumped up fifteen points. At the next reading, a minute later, it may be down again. Usually, you can detect fidgeting in such cases, side glances at the class, a sigh, or moving of the feet. Often, the instructor is sufficiently acquainted with his students so that he can select the type he wants to demonstrate.

Respiratory changes

The movements of the chest during breathing may be recorded by means of a pneumograph. This instrument, in its simplest form, consists of an elastic rubber tube about three quarters of an inch in diameter, held extended by an inner coiled spring. One pneumograph may be placed high on the chest and fastened by a strap running around under the arms. When the subject inhales, and thus expands his chest, the tube is stretched and sucks in air. If a rubber tube connects the pneumograph to a tambour recorder, the recorder on the tambour is depressed. When the subject exhales, the recorder rises. If this recorder rests against a continuously traveling paper, a curve of the inspirations and expirations is traced. A second pneumograph may be fastened around the trunk in the region of the lower ribs. Movements of the recorder attached to this pneumograph will give some indication of the depth of breathing when compared with the tracing from the thoracic region.[3] The complete apparatus is pictured in Figure 36.

Under various conditions, it has been found that the breathing may increase in rate, may vary in depth, or may show a change in the relationship between inspiration and expiration. This latter relation is usually expressed as the *inspiration-expiration ratio (I/E)*—that is, the duration of the inspiration divided by the duration of the expiration. The I/E is considered to be greater during excitement. In one investiga-

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[3] Valentine, W. L., and Stanton, F. N., *Some Physiological Reactions to Emotional Stimuli*, a motion-picture film (Columbus, Ohio: Ohio State University, 1932).

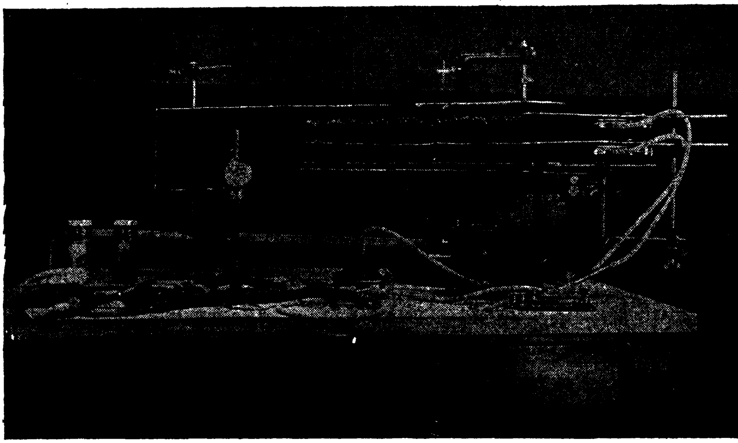

FIGURE 36.—APPARATUS FOR RECORDING RESPIRATORY AND CIRCULATORY CHANGES. The upper line on the smoked paper is the breathing record; the second line represents changes in blood pressure; the third line indicates points at which stimuli were applied or conditions changed; and the lower line indicates the time in seconds.

tion,[4] breathing records during quiet relaxation and during several activities were compared with the following results:

1. In mental multiplication, as compared to the resting condition, breathing was quick and shallow.
2. In "anxious expectancy," the rate was generally somewhat increased, but the depth remained normal.
3. After surprise, the rate was high and the depth normal, but breathing was irregular.

It is interesting to note at this point that physiological investigations demonstrate that, in physical exercise, respiration and circulation are immediately stepped up. In other words, these changes are not delayed until the onset of oxygen want or excess carbon dioxide. The muscular activity serves as a stimulus or warning in advance of the actual need for these increases. Presumably, the emotional situation stimulates the same responses.[5]

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[4] Skaggs, E. B., "Studies in Attention and Emotion," in *Journal of Comparative Psychology* (1930), Vol. X, pp. 373–419.

[5] Cannon, W. B., *The Wisdom of the Body* (New York: W. W. Norton and Company, 1932), p. 311.

The galvanic skin response

You have doubtless observed that, when some individuals are excited or embarrassed, beads of perspiration stand out on their foreheads. You may also have noticed that the palms of your hands are sometimes moist. The palms are extremely sensitive to emotional conditions. Try to remember the next time you are embarrassed or worried to look at your palms. You may be able to see the tiny droplets of perspiration oozing through the skin. Because the sweat glands are so responsive to disturbances, and this salty moisture reduces the skin resistance to an electric current, the measurement of the changes in this resistance is an excellent indicator of variations in the emotional tone of the subject.

One electrode is attached to the palm. The other electrode, for convenience, may be placed on the back of the hand. These electrodes are then connected with a low-voltage battery and a sensitive galvanometer. Preferably, the galvanometer is placed in a Wheatstone bridge circuit, so that the fluctuations in body resistance can be magnified and easily observed or recorded. This set-up may be so sensitive that the slightest change of the subject, such as a deeper breath, will be indicated by the galvanometer. It is therefore necessary to adjust the sensitivity of the circuit in accordance with the conditions of the experiment. Frequently, the deflections of the galvanometer are projected upon a screen by the reflection from a small mirror attached to the moving coil of the galvanometer. In more refined experiments, the reflection is photographed on a moving film. One type of this apparatus is shown in Figure 37.

An experiment may proceed somewhat as follows: The subject is comfortably seated in a quiet room and relaxed. A word is pronounced; after a few seconds, another word is given; and so on through a considerable list. Some of these words are designed to be "significant"—that is, they have some emotional association for the subject. Other words are "neutral."

In one investigation [6] using the photographic method of recording, a list of fifty-five words was read to students whose emotional tendencies had been judged from the autobiographies previously written by these students.

Following some words there was a definite deflection of the galvanometer. These records were analyzed according to their

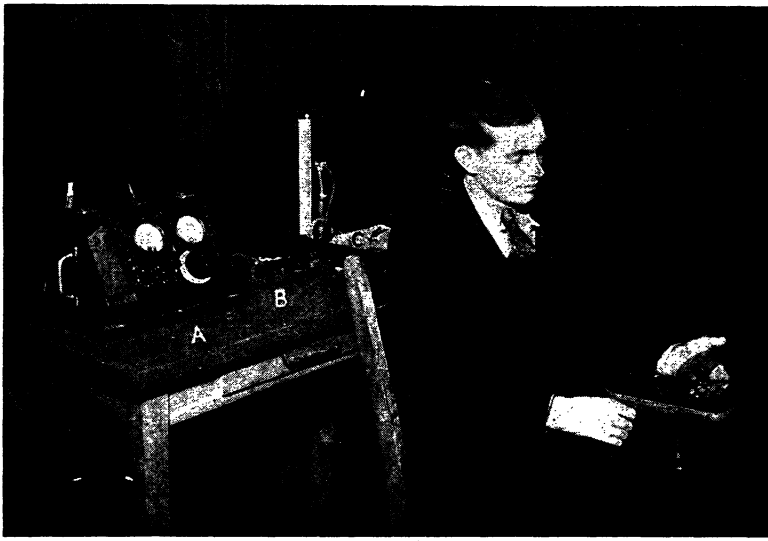

FIGURE 37.—From *The Psychology of Feeling and Emotion,* by Ruckmick (McGraw-Hill, 1936).

amplitude, duration, and shape. It was found that those students whose autobiographies indicated that they were steady workers, well contented individuals with few or no worries, gave the fewest galvanometer deflections; while those who had reported shyness, or were easily embarrassed, or acted upon impulse, exhibited the greatest number of deflections. On the other hand, there was no evidence that the curves of deflection could be distinguished for different kinds of emotions.

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[6] Syz, H. C., "Psychogalvanic Studies of Sixty-four Medical Students," in *British Journal of Psychology* (1926), Vol. XVII, pp. 54–69; 119–126.

An experiment combining techniques

The following experiment is a good illustration of the laboratory methods employed to combine several techniques for the study of reactions to situations that may arouse startle or fear: The subject was seated in a specially constructed chair. Records were taken on three successive days under normal conditions. During the third experimental period, the chair was released without warning, so that the subject was allowed to fall backward, without injury, about sixty degrees.[7]

An electrocardiograph was used to record the heart action. This instrument consists of a delicately adjusted string galvanometer and a photographic device that records alterations in the position of the string. Since any muscular activity will be accompanied by electrical changes, each heart beat is recorded. The galvanic skin response was also recorded. A pneumograph recorded the duration of each inspiration and expiration in breathing.

An examination of Table VII will show that the heart rate was increased suddenly as a result of the fall. The rate of breathing decreased, but the respiratory ratio (I/E) increased from .74 to 2.08. This increase is a commonly observed phenomenon in such experiments, although a decrease in the I/E is also reported in some emotional situations. The general galvanic skin responses are also discernible.

Lie detectors

Several investigators have attempted to use one or more of the above-mentioned methods for the purpose of detecting lying and guilt with reference to a crime. These investigations are based upon the assumption that a subject will be more disorganized when confronted with the facts of the crime if he is guilty than he would be if innocent. The results are not entirely conclusive. The experiments carried out in the laboratory are usually too artificial, although this is not always

[7] Blatz, W. E., "The Cardiac, Respiratory, and Electrical Phenomena Involved in the Emotion of Fear," in *Journal of Experimental Psychology* (1925), Vol. VIII, pp. 109–132.

the case.[8] The so-called "lie detectors" consist of assemblies of the same techniques as have been described.

Let us take the case of theft of clothing, a watch, and other articles from a room in a fraternity house. Any one of three members living in the house might have been guilty. After careful investigations of the circumstances surrounding the theft, there was performed an experiment in which eight mem-

TABLE VII

A Comparison of the Effects of the Initial Fall with Naïve and Informed Subjects

Type of Response	*Naïve Subjects*	*Informed Subjects*
Cardiac Responses:	16%	17%
Initial acceleration	To normal	14%
Ensuing retardation	10%	7%
Secondary acceleration	3 minutes	2½ minutes
Duration of effect		
Respiratory Responses:	14–11 (20%)	16–14 (12%)
Change in rate	5 minutes	3 minutes
Duration	.74–2.08	.80–1.61
Change in index value	5 minutes	3 minutes
Duration	Marked	Marked
Inspiratory stimulation		
Electrical Responses:		
Degree	Marked	Fairly marked
Duration	6 minutes	2 minutes

bers, including the suspects, were examined by the *association method.* The technique was as follows:

A list of eighty words having no relation to the crime was prepared. Twenty words that might be directly associated with the crime were inserted in this list at irregular intervals. These are called "significant" words. Each subject in turn was instructed that, when a word was pronounced, he should reply as quickly as possible with the first word that the stimulus word suggested. The reaction time for each response was

[8] Burtt, H. E., "The Inspiration-expiration Ratio during Truth and Falsehood," *Journal of Experimental Psychology* (1921), Vol. IV, pp. 1–23. Also: Crosland, H. R., *The Psychological Methods of Word Association and Reaction Time as Tests of Deception,* University of Oregon Publications, Psychology Series No. 1 (1929), Vol. 1, p. 104.

recorded by means of a stop watch. Blood-pressure and breathing records were also taken throughout the experiment. When the results for all subjects were compared, the records of one subject, who later confessed to be guilty, showed marked differences from the others:

1. His mean reaction time in replying to the significant words was greater than for the other eighty words.
2. In three cases, the word that was associated with the significant stimulus word bore directly upon the crime.
3. In two other cases, his reaction time was exceptionally long.
4. His blood-pressure record was more irregular than the records of the other subjects.
5. His inspiration-expiration ratio was slightly more irregular than the ratios of the other subjects.

All of these attempts to substitute the scientific methods for the old "third degree" are hopeful, but the problem is so complicated legally that little success can be expected until more thorough investigations are made. Psychologists are not yet agreed as to just what is being measured in the so-called "emotions." We cannot assume that blood-pressure records, breathing curves, and galvanic phenomena are a true index of truth and falsity. When the accused is attempting to recall a date, these records may or may not vary in the same order that they would if he were trying to cover up the truth. Because of its importance and because of its intricacies, the problem is one of the most interesting in present investigations.

9

Emotion in Everyday Life

Classification and Naming of Emotions

During your reading of the preceding chapter, it must have occurred to you that, basically, all emotional behavior is the same. Emotion is disorganization, disturbances of various degrees and extent centered chiefly in those parts of the body served by the various divisions of the autonomic nervous system. However, from a subjective point of view as well as from our observation of others, we have reasonable assurance that emotions are different from each other. Fear is different from rage, and rage is not the same as love. How can these distinctions be made? How can we distinguish differences between the emotions?

Visceral patterns

First of all, we might look to the visceral disturbances that characterize emotion to see if the basis for a distinction might lie there. Our search in this direction, however, will not be very fruitful. Although some differences in the *pattern* of visceral disturbances that form the core of the several emotions have been noted, these differences are not reliable, and show rather considerable variation from person to person and within the same person at different times. In effect, this means that, if a subject were concealed behind a curtain with only instruments like the recording tambours and galvanometers that we have described visible to you, you would not

be able to tell which of several emotions was occurring in the subject behind the screen. With only the information from the dials and other recording instruments to go on, you could not tell by such readings whether the subject had been frightened, insulted, kissed, or excited in some other way. In other words, we could not name the emotion with only this information to go by. Nor could you tell whether the emotion had been a pleasant or unpleasant experience from the standpoint of the subject himself. In spite of our inability to distinguish between the emotions on the basis of the visceral reactions, investigators in this field suspect that more careful measurements may be more helpful in the future. And so it may be that our inability to make distinctions at the present stage of our knowledge will be remedied eventually.

Behavior patterns

After trying to distinguish between the emotions on a basis of the visceral reactions only, you might suggest that you would be more accurate if you could see and hear a little more of the subject's behavior. And so, after the stimulus has been applied, the screen is removed. Now you watch the subject carefully and perhaps even entirely disregard the instruments that tell you about his pulse, respiration, and other visceral reactions. You observe the subject's facial expression carefully, you note the general posture of his body; and on a basis of these observations, you will be somewhat more accurate. It is surprising how wrong you can be, however, even with this much information. Photographs have been made of subjects experienced in dramatics who have been instructed to express certain emotions. The persons seeing the photographs are directed to judge which of the emotions the performer is trying to express. The confusions that result when these pictures are shown are fairly uniform. Expressions of excited expectancy, for instance, are confused with fear; reverence is confused with love. It is conceivable that part of the trouble is with the actor and that actual situations would result in more successful guessing.

To secure genuine emotional expressions, one investigator

photographed the same small boy under the following situations:

1. A man puts on a false face a second time.
2. A new toy with which the child is playing is abruptly removed.
3. Playing peek-a-boo.
4. The child's trunk movement is restrained by his being bound to chair.
5. A substance having a strong taste is placed in his mouth.
6. A ticklish area is stroked lightly with a pencil.
7. Watching two small boxes being stacked up and knocked over several times.
8. Accidentally falls down, receiving severe bruise.
9. A bottle emitting a strong odor is held under his nose.
10. Confronted suddenly with a man wearing a strange false face and growling.
11. A dropped object inflicts a slight bruise.
12. A finger is thrust down his throat, touching the root of his tongue.
13. Gets his head bumped accidentally.
14. Handcuffed.
15. Confronted with loud horn sounds.

If you will try to identify each picture in Figure 38 that corresponds with a specific situation, you will find the task very dissatisfying. Some of them seem easy to identify, but many of them are confusing, and you will make mistakes even with those where you have the most confidence.

Figure 39 is perhaps an extreme case, but it illustrates the point that facial expression is not a good basis for classification of emotions. The picture on the left was taken as a sprinter finished the hundred-yard dash. The one on the right was taken while a man was being tortured for the occasion. One hand was being pinched and twisted with a pair of toothed pliers. At the same time the torturer's heel was being ground on the victim's foot.

What part of the face is most expressive? Children are believed to be able to discriminate the character of strangers

FIGURE 38.—PICTURES OF A CHILD TAKEN IN VARIOUS EMOTION-PROVOKING SITUATIONS.

FIGURE 39.—FACIAL REACTIONS. The man at the left is finishing the hundred-yard dash. The man at the right is suffering severe pain.

by the expression of the eyes. *"Sie kennen die Augen"* is an old German saying which is generally believed. "He has a shifting eye" and the "eyes of innocence" are familiar statements. When photographs taken during emotional situations were cut horizontally just below the eyes, and the upper half of one picture was attached to the lower half of another, judges

more frequently identified the situation belonging to the lower half rather than the situation belonging to the upper half.

Numerous studies of emotional expression have been made by using actors to portray emotions by facial expression, voice, and hands. These are really tests of conventionalized expressions. You nod your head to express "yes" and shake your head to say "no." The actor or one proficient in public speaking is skilled in these conventionalized expressions. Hence, it is easier for the subjects to identify the expression intended when it relates to the more common emotions, but he misses the subtler emotions or feelings portrayed.

Stimulating situations

Usually, after people have been asked to judge emotions from expressive movements, they will say: "I think I could do better if I knew what had happened to the subject just before you started to take the picture." And so, with the complete picture of the emotion-provoking situation, the responses of the subject and some background in your own experience, you are now able to judge fairly accurately just which emotion is being experienced by the person whose behavior you are observing. This is the basis upon which we can and do name and classify emotions, not only as they appear in the behavior of adults, but also as they appear in the behavior of infants and in animals. In the case of the adult, we can check the accuracy of our naming by asking the subject just which emotion he was experiencing. In the case of infants and animals, we have no check. We attribute to them the same emotions that appear in the adult, and let it go at that. It would be interesting to discover how often we are wrong and how often right in our naming of the emotions of very young children and of animals. On a basis of some of the work that has been done, we might suspect that rather gross errors are made. Even mothers are not infallible when they interpret the cry of their child as an expression of fear or of discomfort or of resentment. At least, we are not able to get judges to agree as to just what emotion an infant or an animal is experiencing at a given time.

In summary, then, emotions are named and classified in terms of several factors:

1. We must have some information concerning the nature of the visceral elements of the response. This aids us in determining the character of our own emotional behavior.
2. We must be able to see a considerable sequence of the behavior of the person experiencing the emotion.
3. We must have some knowledge of the stimulating situation.
4. We must have been through a similar experience ourselves in order to be able to ascribe correctly our own responses to those we observe.

Emotion and Motivation

When we talked about the origin and development of motives, we pointed to the fact that all motives are traceable to various physiological conditions that usually consisted of tensions or upset equilibria in various parts of the body. Now, it seems apparent that one of the natural developments during emotional behavior would be the creation of tensions in many places in the body. Physiologically, these tensions would be indiscernible from those that are part of many drives. We may expect, therefore, that the organism will persist in certain forms of activity until the tensions are relieved. Emotion thus serves the same function as a drive. Emotions are tensions that generally increase activity. Usually, this activity persists until the tension is removed. Thus, learning becomes associated with emotion in the same sense that it is related to the satisfaction of the tissue conditions that we called *drives.*

Anticipatory behavior that prevents emotion will be established in the same way as it does in preventing hunger. Thus, we may say that the organism is "motivated" by fear, love, hatred, jealousy, and many other emotions. Rather complex behavior sequences may be founded upon such drive conditions. It would be a safe gamble, for instance, to say that much of your own behavior with respect to your college work

is motivated by a fear of "flunking." This does not mean that your college work itself is emotional (although it can be), but it does mean that much of what you do is anticipatory to fear in the same sense that other things you learn to do are anticipatory to hunger, fatigue, and other similar conditions.

There are two points to be remembered when we consider that emotions are motivators:

1. In the first place, some of the behavior associated with certain of the emotions appears to be in the nature of an attempt to maintain the emotional condition. The behavior associated with love, for instance, is of this type. Instead of ridding the organism of the tension created by the emotion, everything that is done seems to be in the direction of maintaining the condition. The same thing is true for other emotions such as patriotism, awe and reverence, and others. Such behavior is very similar to that which we have noted as being associated with such bodily conditions as the "feeling of well-being" that accompanies the equilibrium of all bodily processes.

Unlike the latter, however, the so-called "pleasant" emotions cease to be agreeable if continued over extremely long periods of time. It is hard to put a finger upon the exact structural basis for the change which occurs when "pleasantness" becomes "unpleasantness." The change in the behavior of the organism may be rather remarkable, because everything he does is in the direction of ridding himself of the once desired situation or object. You have undoubtedly gone through this experience yourself. Objects and situations that were once highly desirable and constantly sought after cease to please or may actually elicit emotions of disgust and remorse, and you have done everything you could to avoid them. To call this phenomenon "monotony," "boredom," or "lack of interest" is simply to give it a name, and does not describe or explain it at all.

2. The second point to remember is so obvious that it needs only mention. Emotions serve as motivating devices only when the disturbance is relatively mild. If the disorganization is widespread, continuous, or complete, learning is not

only not helped but is actually interfered with. Before the emotion is of any use as a motivating device, it must be at least partially eliminated or brought under control by methods that we shall describe presently. A student in love, for instance, may do both better and more work than when there was no such motivating condition. On the other hand, a student love affair can be so completely disorganizing that, not only his schoolwork, but also his health and his relations with his friends are seriously interfered with. Just which will happen in a given instance is, of course, dependent upon a number of circumstances. Surely, you have seen "college engagements" that have turned out beautifully for all concerned. The contracting parties seemed to "settle down" or "perk up," as the case may be, and the tenor of their lives takes on new meaning and direction. Other similar affairs have been rather tragic and pathetic illustrations of what can happen when a person meets a situation for which he has no adjustment and becomes, for the time being at least, a disorganized and ineffectual personality. Exactly the same situation will result when fear is the chief motive. A mild fear of failure is very effective as a drive to further learning. But if too much pressure is exerted by friends, fraternity, or relatives, the emotion may become intense enough to completely prevent effective college work.

Disorganization of motivated behavior

You probably can recall many instances where an individual has succeeded in meeting critical situations while undergoing an intense emotion. For this reason, you may be inclined to insist that he met the situation satisfactorily because of the emotion. If one is angry, he reacts vigorously against the frustrating circumstance. He knocks down his opponent, or he works harder "to show that bird" that he can do his job. Or, if it is a case of fear, he flees or attacks the situation in order to eliminate the fear-producing situation. You have assumed that the violent emotion of anger or fear is the motive to the behavior. This is a misinterpretation of the facts. THE EMOTION FURNISHES A DRIVE TO ACTIVITY; THE KNOWL-

EDGE OF THE SITUATION OR THE GOAL TO BE ATTAINED IS THE MOTIVE. THE EMOTION INDICATES THE DISORGANIZATION OR DISSIPATION OF ENERGY.

An interesting example has been reported of an account of the rescue of a child whose garments were on fire. This has been taken as illustrating the effect of emotion in overcoming a dangerous situation. You will see that fear as recognition of danger and fear as the emotion were confused in this case. The account of the facts is as follows:

A short time before breakfast, *R* was sitting alone before the fireplace. Alice, six years old, came in and stood with her back to the fire. She still had on her night garments, over which she was wearing a flannelette dressing gown. She backed a little too near the fire, and without an instant's warning, the whole back of her outer garment was enveloped in flame. At the very instant that *R* saw the flame over Alice's shoulder and heard her outcry, there came the memory of the terrible burning of his sister and another child, together with the "feeling of condemnation of garments of this sort."

There was a sudden automatic impulse to action. Four main alternative possibilities presented themselves together: (1) to smother the flame with the garment itself; (2) to smother it in a blanket or something similar; (3) to smother the whole with water; and (4) to pull off the garment. The fourth alternative was settled upon as offering the greatest chance of success. His whole action system, he reports, operated for the twofold task of keeping the flame from the child's face and removing the garment by stripping it off over her head. This was accomplished with more hard jerking and hauling than was really necessary, Alice being thrown to the floor after the garment was torn off. *R* also reports that the burning of his hands and the danger of setting the house on fire were recognized, but they were of minor significance as compared with the main task of rescuing the child. He also believes that he resorted to rather inarticulate, but very vigorous vocalization.

In this case, we find that *R* managed to solve his problem in a fairly efficient manner. He was able to summon his re-

sources for the occasion and to perform the task successfully, although he undoubtedly displayed many unwarranted and useless movements. Let us assume that his previous training had been different—that, as a child, he had learned to react emotionally to fire, that he had never learned to meet new emergencies, and that he had never developed a sense of responsibility for others. In this case his behavior would have been more disorganized and less effective. He might have run from the room or stood frozen to the spot while the child burned. On the other hand, if it had been his business to strip garments off flaming children every morning, he would have been able to perform the task with greater precision and less violence. He would not have thrown the girl on the floor or resorted to "rather inarticulate and vigorous vocalizing." It is quite evident that *R* performed his task in spite of the emotion. He was able to maintain a certain degree of control when he recognized the task to be performed.

Delayed emotion

This same principle is illustrated in cases in which there seems to be no great emotional reaction [1] at the time of the incident, but as soon as the emergency is over, the individual collapses.

A student reports that his car stalled on the railroad track and a freight train was approaching. He quickly readjusted the carburetor, started his engine, and drove off the tracks in the nick of time. A few rods up the road he became so emotionally upset that he had to stop. He reported violent trembling, dizziness, and nausea. In this case, a recognition of danger motivated this student to the highest degree of coordinated activity. But when he was out of danger, this motive was no longer present; and the persistent knowledge of an accident narrowly averted resulted in a breakdown. Had the emergency continued, he might have been able to maintain

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[1] Stratton, G. M., "The Function of Emotion as Shown in Excitement," in *Psychological Review* (1928), Vol. XXXV, pp. 351-366.

the adjustment, although it is also possible that the strain might have proved too great to be endured for any length of time.

Another student reported a similar incident. He and his girl were driving one evening when a car about a hundred yards ahead was "side-swiped" by another car and turned over. When he arrived at the scene of the accident, he found all the spectators standing about helpless in the emergency. He took charge, directing the men in lifting the car; and he himself pulled a girl out from under the car, placed her in his own car, and, with the aid of his girl and one of the other men, took her to the hospital, where she was pronounced dead. He then took his girl to her home and returned to his own house, only to collapse on his own doorstep. He declared that, up to this moment, there had been no indication of his own breakdown. The truth of this statement may be doubted, but the facts of the case warrant the belief that the major activities constituted well-organized response while that was needed. With the situation past, and as a result of the strain and fatigue in making the adjustment, the more complete breakdown occurred. Emotion does not occur in critical situations if you have a ready response. In such cases, the emotion or disorganization may be exhibited after the goal has been attained and the motive for organized behavior no longer exists.

Regression

One of the symptoms of violent emotion is the tendency to fall back upon earlier modes of response. We *regress* to childhood types of behavior, or we regress to lower levels of response, socially considered. The story is told of a college president who went fishing with three associates. The president caught a big fish, and the other men in the boat began instructing him how to maneuver it. During the course of the play, everyone became more and more excited. At the same time, the president's language became more ungrammatical, until he ended in a string of profanity that none of the men had even heard him use. The students in the class-

room shooting experiment were chagrined at their own behavior because it was not up to their own standards. We hear the statement that the grief-stricken man "cried like a child." Lovers appear silly to onlookers. In a fit of anger, we display our "lower selves."

The restrictions of daily life require that we behave in certain ways, assume manners that have to be constantly guarded. You have caught yourself lapsing from the conventions of society, excused yourself and offered your seat to a lady, or allowed her to enter the elevator before you. The businessman, lawyer, doctor, and professor live each according to the rules of conduct established for his profession or social status. Each, on occasion, lapses into his earlier unrestrained attitudes. The professor plays bridge or chess with the same childish abandon that the boy of twelve plays checkers or authors. The judge spends two weeks on a fishing trip. He sleeps on the ground, cooks his own meals over a campfire, neglects to shave. His clothes are dirty and ragged, and his language does not betray his position. All this is a release from the rigors of a highly organized life.

Occasionally, the stress of life becomes too acute, and the emotional breakdown becomes so complete that the individual displays serious infantile behavior. During the First World War, some "shell-shock" cases gave evidence of regression.[2] A young man who was sent to the hospital after several months at the front, displayed a completely childish condition. He sat in bed, alert and lively, and displayed his few possessions with childish interest. He seemed to have no knowledge of ordinary objects. When stood upon his feet, he walked with legs far apart, like a child just learning to walk. When permitted, he dropped to the floor and crawled like an infant. Yet, the regression in this extreme case was not complete. He recognized a cigarette and smoked it; shown a picture of a steeplechase, he was able by gestures to show that he recognized it; and upon being taken to the pool, he stripped off his clothes, dove in, and swam.

[2] McDougall, William, "Four Cases of Regression in Soldiers," in *Journal of Abnormal Psychology* (1920), 15, pp. 136–156.

Unpleasant Emotions

Fear

It is unfortunate that we have no satisfactory words in our language to distinguish between the fears that are marks of our knowledge of danger and the fears that are the result of no adaptive behavior. A pedestrian refuses to cross the street in the middle of the block, and he waits for the green light at the intersection. If a car is approaching, he may hasten his pace or even jump to avoid getting hit. All this is the expression of *fear*. But does he necessarily experience an emotion? He is merely exhibiting a good adjustment to the situation. He has learned that, to cross in the middle of the block, is dangerous and that not all drivers can be trusted to stop at a red light. He further has learned how to protect himself in such situations.

Now, place this same man before an audience to which he is to speak. He stammers, fusses with his papers, looks at his feet, blushes, and beads of perspiration form on his face. He knows no one is going to do him any physical harm. Yet he is suffering an *emotion of fear*. The situation is new to him, and he has not learned how to deal with it.

There are many things that we will *not do* because of fear, and there also are many things that we *do* because of fear. The term *fear* here connotes a response to a danger situation, but it may be highly organized. No emotion need be assumed. Some people will not travel by airplane because they are afraid. Some people talk rapidly because they fear questioning. Emotion is avoided by beating the emotion-provoking situation "to the draw."

We are all subject to many fears. Many of them do not obtrude upon our daily routine because we are occupied with activities where these situations are not important. Many people fear snakes and wild animals, for example, but there are no snakes and wild animals present. Some, however, are afraid of strangers; or they cannot ride on elevators; or they faint at the sight of blood. Many of these emotional reactions

interfere with successful adjustments to our daily social situations. Suppose, for example, that you are so disturbed by a crowd of people that you cannot enjoy a movie or a concert. You can avoid such places, but you soon find that you are extremely limited in the places where you can go; or you become a recluse, shut off from most human contacts.

Phobias

A *phobia* is an intense fear. It differs from "normal" fears in that it is much more readily elicited and seems to involve more widespread disturbances. During a true phobia, the whole activity is dominated by this intense fear. The entire adjustment of the organism is interfered with. It is not necessary that the disorganization be wholly explicit—that is, the implicit disturbance can be quite as devastating on the adjustment of the moment. Usually, the individual will "freeze in his track," scream, or run very hard, or in some other way give external evidence of the completeness of the breakdown; but this is not necessary for the fear to be called a *phobia*.

A frequent cause of phobias is the avoidance of certain fear-producing situations to the extent that no adaptive behavior is ever established. An example of the effects of avoidance of a situation associated with fear was related by an instructor of psychology.

During a lecture on emotion, he mentioned the changes in blood pressure. At this point, one of the men fainted. Later, this man explained that, as a small boy, he had fainted on the school ground when another boy was injured and shed a little blood. He had been ill at the time and had gone to school without his breakfast. The sight of blood in his physical condition was enough to make him faint. Not long after this episode, he had a similar experience. Then he began to avoid bloody situations. He would not go to a meat market; if he was reading a story that suggested a bloody episode to come, he discontinued it. Finally, he declared that he would not have elected psychology if he had suspected blood would be mentioned. Here we have a case of extreme fear that origi-

nated in an insignificant incident, followed by pampering of a disagreeable response.

In contrast to this account is that of another man in the same class. He related that he had fainted under similar circumstances. He finally became indignant at his own behavior and determined to overcome it. He visited meat markets, went to the slaughterhouse, read bloody accounts, and elected any course that might deal with internal organs. The result was that he had become so interested in this subject that he was planning to study medicine.

Often, the fear-provoking stimulus cannot be identified so readily. A young lady had since childhood suffered from a phobia of running water. As a child, she would scream and fight violently when she was forced into the bath. As a young lady, she could not endure the sound of water running from the faucet. When she rode on the train, the curtains had to be drawn for fear that she would see a small stream. She could not explain why these simple, everyday situations should arouse such violent emotional reactions.

Investigation of the history of her case revealed that she had, in her early childhood, developed intense fear of being punished by her mother. On one occasion, she had disobeyed her mother and, as a result, had fallen under a small waterfall. The terror of this situation was combined with the fear of the consequences. An aunt had dried her clothes and promised not to tell her mother. So, in the confusion of this episode, the child had forgotten the major incidents but had retained the violent reaction to water. When as a young lady she discovered all the facts, she was able to make the proper adjustment.[3]

Worries and depression

Worry is an emotion. The stimulating situation is usually some kind of frustration. When motives conflict, or when the satisfaction of some desire is interfered with, the resulting manifestations in behavior are identical in many respects with

[3] Bagby, English, *The Psychology of Personality* (New York: Henry Holt and Company), 1928.

the disturbances we have been discussing. An unresolved conflict or a thwarted motive produces a situation for which there is no immediately adaptive behavior. This, you remember, is a prerequisite for emotion. When a person worries, he is manifesting that he is not adjusting to the situation. He does not have the situation under control. Most frequent worries are about financial matters, one's health, or the health of members of the family, one's relation to the social group or to his profession. For most of us, these emotional states are transitory. You have tried to do the work the professor has prescribed but, time after time, have failed. Then you begin to worry, and your work slumps still further. Finally, you discover what was wrong, and success brings its reward. At other times, your work suffers because you are worrying about something else. Your "girl" is dating other men, or your finances are in bad shape, or you fear that illness is impending.

Often, worries lead to *depression,* a feeling of failure or discouragement, a feeling of the futility of your efforts. You are licked, and you practically admit it. Here we run into another danger that the depressed often fails to realize. He gratifies his personal desires by seeking sympathy or attention from others. Instead of meeting his problems, he pleads his dire circumstances as a means of attracting attention to himself. If he gets this attention and the sympathy that he craves, he may develop a feeling of self-pity and do nothing to solve his own problems.

Grief

The unpleasantness of worry and depression is so closely akin to *sadness* or *grief* that it is not always possible to distinguish the one emotion from the other. Children grieve when their immediate demands are not satisfied, but usually they soon recover. Adults experience grief less often, at least in a violent form, but they recover less easily. The parent who loses a child in whom he had placed great hopes may believe that his grief is irreparable. The hopeful thing is that most people do get over it. This is the most important fact to remember. Other activities must go on, and in time our losses,

although recognized as just as real, still lose their emotional character. Practice is essential. Development of ability to talk about the circumstance, to deal effectively with objects and situations, rather than avoidance of the situation, brings its own relief.

Anger

Some men are "hot-tempered" and some women are "spitfires," but most of us are ashamed if we "lose our temper." ANGER, OR RAGE, ARISES WHEN WE MEET A SITUATION FOR WHICH WE HAVE NO READY RESPONSE, WHEN WE ARE FRUSTRATED IN ACHIEVING OUR GOAL. In a moment of anger, we may throw ourselves into the task more energetically to gain our end; but we also waste energy and, in our confusion, we do or say things that are detrimental to our cause. This is the chief distinction between worry (which is also the result of frustration) and anger. The behavior associated with anger is more aggressive, positive, and in the direction of some goal. Worry, on the other hand, is more passive, aimless, and less impulsive.

Very often, the parent tries to train a child to curb his temper tantrums. The methods are frequently of the sort that bring about polite behavior but do nothing for the implicit emotional response. It is true that failure to achieve your purpose by "throwing a fit" may lead to seeking other means; and the child who is punished or fails to get what he wants does develop satisfactory methods, and thus avoids rage or other emotional outbursts. This should be the main line of attack upon the problem. WHEN YOU ARE THWARTED AND ANGER IS IMMINENT, RESTRAINT IS THE FIRST IMPERATIVE; THEN SEEK PROPER MEANS OF MEETING THE SITUATION. ANGER DOES NOT ARISE IN SITUATIONS IN WHICH YOU ARE ABLE TO RESPOND ADEQUATELY.

Pleasurable emotions

The satisfaction felt in a job well done, the pride of a father in his son, and the joy of meeting an old friend are relatively mild emotions as compared with the unpleasant experiences

of dissatisfaction, disgust, or hate. That is probably why the reactions recorded in the laboratory have yielded so little information on the pleasant emotions. The pleasurable represents the successful adaptation and the satisfactory adjustment to our desires and requirements.

When these emotions become intense, however, they pass over into states resembling closely the manifestations of the unpleasant emotions. When one is "overjoyed," he may weep. The lovelorn youth loses his appetite. The excitement of a football game may become as disturbing as an unfortunate event. So long as we are adjusted to the situation, the experience is pleasurable. To the extent that we become maladjusted or disorganized or confused, the experience becomes unpleasant.

Adjustment to Emotional Situations

Emotions and health

Not only is it important that we make adequate adjustments because it is the efficient method of dealing with our problems, but it is also easy to see that such emotions as fear, rage, love, and worry have a detrimental effect upon the general health of the victim. We have seen in the experimental evidence with animal and human subjects that even relatively mild emotions are accompanied by rather marked changes in digestive processes, blood pressure, and the action of the heart. No wonder that the businessman who is worried over financial problems develops digestive troubles, or his overtaxed heart sends him to an early grave. The distraught housewife has a "nervous breakdown." The lover loses his appetite. The excessive secretion of adrenalin as a part of the emergency reaction is associated in prolonged emotional states with stomach ulcers, abdominal disturbances, exhausted heart, and "frayed nerves." One should avoid excited discussion at the table, and he should get away from his troubles periodically if he cannot otherwise master them. Only the person who is *perfectly adjusted* to his work can safely go on working for long periods without a vacation. Since such people are very

rare, periodic changes in scenery appear to be the most sensible substitute for an effective adjustment.

The elimination of fears

The foregoing discussions give some of the procedures that might be adopted to avoid becoming emotionally disturbed. We often speak of "controlling the emotion," but it is not so much a matter of control of the emotion as it is of control of behavior so that the emotion does not exist. In order to accomplish this task, we may adopt certain rules:

1. Try to discover the origin or particular element in the situation that is the basis of the fear. It is probable that the crowd is not the real cause of fear. It may be fear of fire or of being suffocated.
2. Why are you upset? This may be due to an early experience, or to reading about fires in theaters or schools.
3. Become familiar with the fear-provoking situation. In many instances, this must be a gradual introduction to the object. A child who is afraid of the water will be made more violently afraid if he is forced into the pool too suddenly. It may be necessary for an adult to go only part way in meeting his own problem in order to attain satisfactory adjustments.
4. Development of knowledge and skills in the situation is often important if the situation demands mastery as a part of the individual's life. This may mean learning to talk to strangers. Perfection of speech and having something to say may be what is required.
5. Closely related to rules 3 and 4 is the effect of associating with others who are fearless in the same situation. The subtle suggestion of their activity influences your response. Unwittingly, you become an imitator of their behavior and, through them, learn to meet the situation.

Some people apply the opposite of these rules to their own emotions. They even seem to delight in the fact that they fear many things. Or, if they are not really pleased, they still become socially inadequate. They have avoided so many situations that there is very little they can do satisfactorily.

The elimination of worries

WHEN YOU ARE DEPRESSED OR BESET BY WORRIES, THE BEST PROCEDURE IS TO ANALYZE THE SITUATION AND TRY TO DISCOVER THE BASIS OF YOUR WORRY. There are some things that you cannot do anything about. You simply have to accept them. When these are properly looked at and set aside in your thinking, what are the remaining factors? Some are not worth the worry and others can be dealt with, or new activities can be substituted. Often, one gets relief by talking to a friend or a professor in whom one has confidence. He does not have to be a psychologist, provided he is a "good listener," one who seems to understand but does not advise. By the time you have finished talking, many of your difficulties have vanished. They were not as important as you had supposed.

Writing out one's analysis serves the same function. It is a means of talking to oneself. The pilot of the transatlantic plane that was wrecked upon the coast of Newfoundland and in which Dr. Banting was killed relates that, after hours of exhausting efforts in aimless attempts to get help, he sat down and wrote out a schedule. Eliminating the most helpless plans and taking into account his own condition, the deep snow, and the wildness of the territory, he laid a plan of calmly waiting, building signal fires, and conserving his own strength. Had he not done this, the plane might never have been located. TO TAKE ONE'S OWN TROUBLES IN HAND BY THESE METHODS IS SUPERIOR TO AVOIDING FACTS AND CONTINUING TO WORRY OR BE DEPRESSED.

Summary

It is not possible to make any clear-cut classification of emotions, either on the basis of physiological reactions or the explicit responses—such as facial expression, the voice, or gestures. We are more inclined to identify the different emotional patterns so far as they exist by correlating them with the situations that provoke them. As emotions become intense, their characteristics become more similar, all emotions ending in general disorganization.

The best method for gaining control over emotions is to learn to meet the situations with some adequate response. To do this, it is advisable to discover just what factors are responsible for the emotion and then develop the skills required to meet the situation. This implies that you will practice meeting such situations, not avoid them.

Violent emotions or long-continued emotional states can be injurious to health. The constant overstimulation of the heart, interference with digestion, and the excess drainage on the energy supply through conflicting disorganized responses may be a greater strain than well-organized activities involved in hard work. On the other hand, adjustment to everyday life situations ensures a healthy and happy existence.

10

Attention

Definition of Attention

Popular conceptions of attention are often erroneous. We hear someone say that he "turned his attention" to an object, or that he "concentrated his attention" upon his work. It is true that we often think of attention as a force that we possess and can direct to this or that object as we might turn a searchlight in order to make clear whatever we wish to examine. We scold the child because he does not "pay attention," and the student is told that he could understand the course if he would be willing to "direct his attention" to the subject. These conceptions of attention are carry-overs from a very old and honored notion of attention as a faculty or power of the mind. They are still used in the same way by people who are not very clear as to what they mean by "faculty" or "power" or "mind." Since these conceptions are so shrouded in mystery and uncertainty, we will do well to discard them in our attempt to describe behavior in terms that we can define. Instead, let us consider in detail just what is happening when we can say of a person that he is "attending" or "concentrating."

One evening at the dinner table, the family were discussing a pair of cardinals who were building a nest in the bush outside the window when a delivery man came to the door. As he counted his change, he said rather slowly: "I see the Red Birds won today." The first part of his sentence brought surprise that he, too, was interested in the birds. This was followed by a slight bafflement before the true meaning of his

statement took shape. It was the first day of the baseball season, and the Red Birds were the home team. The family were *set* to expect further conversation about birds, not baseball. Many jokes depend upon building up in the listener the expectation of a certain conclusion and then, at the end, suddenly shifting the conclusion.

Our daily behavior is constantly being influenced by *sets* that we assume. We often remark at the intelligence of a child who reports certain details of his surroundings that an adult would never have observed. In a case of this kind it is not that the child is so intelligent, but that the adult is occupied with observing in a traditional or routine manner, while the child is free to observe anything, regardless of its importance. If you pick up a package that is heavier than you expected, it seems even heavier than it really is. The first course in a new department is often more difficult for you than are more advanced courses later on, simply because you were not set for a particular discipline. For similar reasons, the first course in psychology may leave you bewildered. You have always had conceptions of emotions, memory, mind, and matter. You have heard preachers, salesmen, and others talk authoritatively on these subjects. Hence, you fail to distinguish between the scientific treatment and the popular opinions concerning them. The fact that this chapter bears the name *attention* and that thus far we have been discussing *set* may in itself be a stumbling block.

Posture

Ordinarily, when we speak of the *posture* of a man, we refer to the way he stands, or sits in a chair. He has an erect posture, or he sits in a dejected posture. The "dejected" posture, however, indicates that we infer that the posture is an expression of something other than the way he sits. "POSTURE," LIKE "SET," IS THE TOTAL ORGANIZATION OF THE ORGANISM WITH REFERENCE TO SOME SPECIFIC EVENT OR STIMULUS. We may use the two terms synonymously. In class, your posture may be described as the "serious consideration of the discussion." If the professor, without smiling, makes a

"wisecrack," you fail to comprehend it as a joke. If you are observing a sleight-of-hand performer, and he "accidentally" upsets a glass of water, your posture shifts; and you are not set to observe that, in that instant, he takes a fish bowl from under his coat and slips it under the tablecloth, *all before your eyes.*[1]

Postures may endure for relatively long periods, even though we are occupied with other things. You may write a letter and go for a walk with the intention of mailing the letter when you come to a mailbox. You think no more of the letter, look in shop windows, note the out-of-state licenses on passing automobiles, or go to a movie. As you start home, you recall that you must find a mailbox. The posture of mailing the letter has persisted.

Attention

"ATTENTION" MAY BE DEFINED AS THE SET OR POSTURE THAT FACILITATES THE RECEPTION OF CERTAIN STIMULI AND THE OCCURRENCE OF CERTAIN RESPONSES. A set may militate against attention to one specific object or situation, as well as facilitate another. Thus, a father may be set for his work even though he is not actually working, and the small son may make a proposition that his allowance be increased. When the son persists, the father may assent only later to realize what it is to cost him. We say that he "was not attending" to the proposition. This is preoccupation and is simply attention to other stimuli. Sets or postures interfere with attention as often as they facilitate it.

Behavior Related to Attention

We can understand more clearly the nature of this posture or set that we call *attention* if we examine some of the characteristic responses that we make while attending. Some of these responses are essential (*primary*) parts of the act of examining or attending in specific instances. Others seem to be merely accessory (*secondary*) movements that have no real im-

[1] Burtt, H. E., *Legal Psychology* (New York: Prentice-Hall, Incorporated, 1931), pp. 56–57.

portance; although, for the individual, they are important at the time.

Primary, or universal, movements. MOVEMENTS THAT ADJUST THE SENSE ORGANS TO THE STIMULI MAY BE CONSIDERED AS "PRIMARY MOVEMENTS." Thus, in order to attend to the reading of this page, it is essential that the eyes converge to the same point and that the lens of the eye accommodates for the proper distance. When a person cannot see clearly, he has greater difficulty in attending. We also turn the head when listening to a faint sound, sniff when examining an odor, and roll a substance over the tongue to taste it. We move our fingers gently over a surface when making delicate tactual discriminations, and we balance the small object up and down to determine its weight. All of these movements give us more sense stimulation; they stimulate more receptors or intensify the stimulation of those already affected.

There are also *respiratory* and *circulatory* changes related to the attentive process. Measurement of the rate and extent of breathing show that, with attention to a visual object, breathing is more shallow but more rapid; while to an auditory stimulus, breathing is slower but deeper. The steadiness required in fixating a visual stimulus requires shallow breathing, which is compensated by the more rapid rate. With the auditory stimulus, the slower rate is the primary adjustment.

The circulatory changes that are manifested are an increase in heart rate, a constriction of the peripheral blood vessels, and an increase in systolic blood pressure. These are, in milder form, the changes that we have observed to occur in emotion or in any physical activity. Whenever the organism becomes more active, whether it is attention, emotion, or physical exercise, more energy is expended; and the circulatory and respiratory systems increase their functions as a part of the mechanism in meeting this demand.

Secondary, or individual, movements. The story is told of a boy who was trying to win the daily spelling match. But there was one boy who always beat him. Finally, the first boy observed that the other always played with a button on his coat. He managed to cut off the button, and on that day

spelled the other boy down. HABITS THAT IN THEMSELVES HAVE NO FUNCTION IN ATTENDING BUT THAT HAVE BECOME SO ASSOCIATED WITH PARTICULAR ACTIVITIES THAT, FOR THE INDIVIDUAL, THEY ARE A PART OF THE ATTENTION PROCESS ARE CALLED "SECONDARY MOVEMENTS." Most students do their serious studying seated before a table, book laid flat, and pencil in hand. Take your book out under a tree and try to study. You may have an enjoyable hour, but unless you are accustomed to this procedure, you find that you go "woolgathering." If you were to lie down to read this chapter, you would probably go to sleep. Yet, why shouldn't you study more effectively with skeletal muscles relaxed? You haven't learned to do so. A difficult problem in mathematics requires that you sit erect, body tense, feet tight around the legs of the desk or table, since that is the way you have learned to solve mathematical problems.

Many other movements are not essential even to the individual attending, but they have become habits that neither help nor interfere. You may frown, drum on the table, rub your chin, or pull your hair. Many pencils are chewed up rather than used up. Sometimes these excess movements become so automatized that they are substitutes for attending. A student may look attentive but be startled if the instructor calls upon him. Only the "shell" of attention is there.

The postural substrate

IN ADDITION TO THESE EXPLICIT MOVEMENTS THAT WE CAN OBSERVE TO HAVE SOME PART IN ATTENTION, THERE MUST BE OTHER PROCESSES GOING ON IN THE BRAIN AND THE ENTIRE NERVOUS SYSTEM THAT FUNCTION IN BRINGING ABOUT A PARTICULAR POSTURE. Two theories based upon the evidence of studies of nervous action attempt to give the explanation:

1. The first assumes that some preliminary stimulus initiates a slight excitation, which starts the contraction of muscles but is insufficient to produce actual movement, and results only in placing the organism in readiness to respond. Then the final stimulus re-enforces this initial response, or state of preparedness. Thus the sprinter on the starting line

is already stimulated for a dash by the total situation. The starter's command: "On your mark, get set . . ." is a further preparatory stimulus. Muscles begin to contract. The crack of the pistol is the final stimulus that sends a volley of nerve impulses through the already prepared or highly sensitized neurones to the muscles. This would explain specific sets of this kind. But what about the more general postures? It is difficult to see how this explanation could be applied to such general postures as your alertness for many events that may occur in an average day. You enter a classroom more or less set for academic activities, but you are not set for a specific muscular response.

2. The second theory attempts to explain these postures on the basis of *tonic* activity. It should be understood that nerve impulses are constantly going from the brain to the muscles. These impulses keep the muscles in a state of partial contraction known as *muscle tonus.* Observe a person who is getting drowsy, and you will notice that he sags in his chair, his head drops, and the muscles of his face relax. On the other hand, when he is wide awake, his alertness is indicated by a complete change in muscle tonus. On this theory, it is believed that these tonic nerve impulses originate in an area of the cortex different from those that have to do with *phasic* impulses or movement. This tonus is believed to provide the preparatory set by "sensitizing" the organism for a variety of responses.

Both theories are probably correct, but incomplete by themselves. The second deals with the origin, the first with the results of the stimulation and reaction-producing posture. By a combination of these two explanations, we may assume that the tonic contractions provide a general posture of readiness and that the initial phasic response is then the specific set within the totality of possibilities. We shall see how this explanation fits the conditions described in the next section.

The conditions of attention

WHY WE ATTEND AND TO WHAT WE ATTEND DEPEND UPON MANY FACTORS THAT WE CALL THE "CONDITIONS OF ATTENTION."

Some of these factors are recognized as existing in the environment, such as the intensity of the stimulus, its duration, and whether the object moves. Other factors we attribute to the individual, such as his previous training, the immediately preceding activity or set, his purpose or motivation at the moment, and the way he is inclined to react to the social influences of his group. It should, however, be clearly understood that these two classes of conditions are not independent of each other. Whether we shall notice a relatively loud noise depends upon our previous familiarity with it, what we are doing at the time, and what our purpose is at the moment. Also, a relatively weak stimulus may "attract" attention because it fits in with some immediately preceding activity or our purpose at the moment. ALL OF THE CONDITIONS CO-OPERATE OR COMPETE IN DETERMINING OUR ATTENTION.

Environmental factors:

1. *Intensity.* If you speak to a person who is already preoccupied, and he does not answer, you speak louder. The intensity of the stimulus must be proportional to the degree of set for something else, or inversely proportional to the degree of *sensitization* for this particular type of stimulus. The contrast of white on black, or a bright light in the dark, attracts the attention of the inattentive driver at dangerous crossings. The best illustrations of the place of intense stimuli in getting attention are, of course, those situations in which attention is already on something else. The lecturer who shouts at an attentive audience may distract his listeners from the main points of his lecture. Some amateur instructors make this mistake.

2. *Duration and repetition.* The low-pressure house-to-house salesman gives the bell button one short push. He knows that, although the intensity of the ring is the same, the short duration may not be enough to bring a response. You wind your alarm clock tight because it takes a lot of ringing to awaken you. There are two reasons for this effect:

a. The longer the stimulus endures, the more its hammering

breaks down the resistance in your nervous system. If you were already set to wake up, no such bombardment would be necessary. Some people maintain a posture with reference to the striking of the clock. Because they hear it every hour, they believe they have been awake all night.

b. The other reason that a prolonged stimulus is effective is because of the variability of our postures. We are constantly shifting, and are therefore more susceptible to the stimulus at one moment than at another.

Repetition is a special case of duration. It is like white stripes on a black ground. The interruption of sound by silence has the effect of greater intensity as well as duration. Flashing signs, intermittent alarm clocks, and the repetition of statements that you wish to emphasize are good examples.

3. *Movement.* We see an object more readily when it moves, and we hear or pay attention to a siren with varying pitch. The movement of electric signs catches the eye. The flagman at a railway crossing must wave his flag to get our attention. For many animals, immobility is a protective response. A moving stimulus introduces a new principle. The moving object stimulates many receptors. Some of them may lead to nerve connections that offer less resistance than others. At the same time, movement, like repetition, produces a contrast effect.

4. *Size.* If you turn the pages of an illustrated magazine, you will observe that the larger the advertisement, the more likely you are to notice it. Size produces a greater stimulation, and is therefore more akin to the intensity factor. It also affects more receptors and resembles the moving stimulus.

The personal factors:

1. *Training.* We include in this category the total background of experience, the general habits of adjusting to the everyday world, specific skills, and knowledge gained from books or in the classroom. If we know an individual's general and specific training, we know pretty well what will appeal to him. The farmer on a trip to another state observes the

quality of the soil and the condition of the crops. The city man misses these, but observes other things that are more in line with his past. You visit a friend's new home, and you note the arrangement of rooms or form a general impression of the whole house. His carpenter friend notes all the imperfections of workmanship.

We all have a relatively common background. We have had some contact with extremes of weather, food, automobiles, adjustments to our associates, strange situations. For this reason, we may expect a common type of reaction. If this were not true, the advertiser would be at a loss as to how to get the attention of the consumer to his product. Millions listen to the radio because the program touches events of their own experience in some subtle way. This is one reason why it is easier for most of us to read a novel than it is to read a scientific treatise. The novel deals with common, human experiences. The scientific treatise deals with events that we meet only rarely in this form in the laboratory.

2. *Immediately preceding activity.* Although habits rule our attention to a great extent and make our behavior quite predictable, the constantly shifting postures influence our variability. Immediately after reading this discussion of conditions of attention, if you pick up a magazine, you are more likely to notice what techniques have been used by the advertiser to get the attention of the reader. Your previous set leaves you more sensitive to anything closely related to the preceding activity.

3. *Purpose or interests.* All of the factors that set up goal-directed activity are influential in directing attention. If you are going on a vacation and plan to add a bathing suit to your equipment, you are likely to observe bathing suits on display and to notice the small advertisement in the upper left-hand corner of the page of a magazine. Your purpose may derive from a question asked on a quiz. The following is a simple classroom demonstration: The students are told that a card will be exhibited for a second, and they are to note how many *X*'s there are on the card. After they have made their report, they are also asked how many *O*'s there are.

Actually, there is an equal number of X's and O's. Usually, they report more X's than O's.

Another example is illustrated by Figure 40. You readily recognize a number of infants and that the general contour of the whole picture slightly resembles the cerebral hemispheres. When a large chart containing this picture was substituted for one of the brain, accompanied by a discussion of fissures and convolutions and the possible localization of a

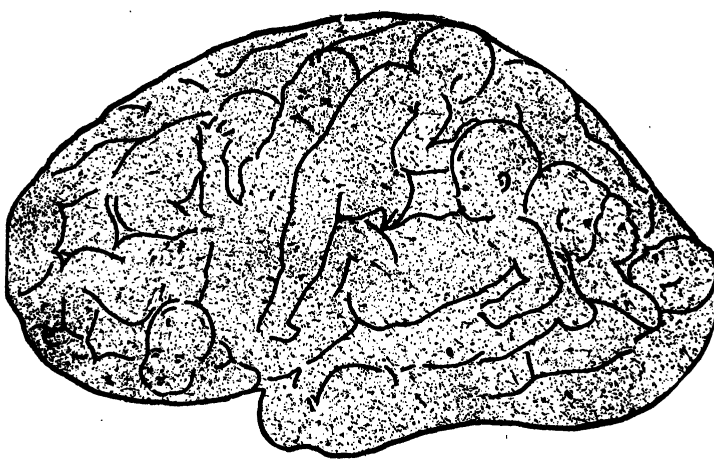

FIGURE 40.—WE SEE WHAT WE ARE EXPECTING TO SEE. (*Titchener after Gudden.*)

cortical center of attention, it was several minutes before any student realized the true nature of the picture.

4. *Social factors.* Often, we attend because we are influenced by the group. Often the group exerts pressure upon our activity. Thus, you may study for no other reason than because you do not want to appear ill-prepared before the other members of the class. You read the news, not because you are really interested, but because others do. What influence the group may have in directing our attention depends upon how much we have become part of it. Social stimuli become effective only insofar as we have learned to react to the behavior of others.

The Efficiency of Attention

Facilitation and inhibition

When we said that attention is the set of the organism that facilitates the reception of certain stimuli and the occurrence of certain responses, it was implied that other stimuli are not attended to and other responses do not occur. We know that we do our best when the stimuli to which we are responding all relate to the task at hand. When attention "wanders," we fail to understand what we are reading, or we make mistakes. Many automobile accidents are attributable to the fact that, although the driver may be "wide awake," he is not attending to those particular parts of his environment that are important to good driving. Some people have wondered whether a radio in the automobile is a cause of accidents. There is no clear-cut evidence on this point for two reasons: (1) car radios are so common that they will be found in most cars—both in those that are and those that are not involved in accidents; and (2) one effect of a radio is to reduce speeds on the open highway, which, of course, would tend to cut down accidents. In specific instances, however, it will happen that, if the driver is attending to the sound of his radio, he will not be attending to other auditory stimulation, and may miss the sound of the horn of another car or a warning spoken by a passenger.

When attention to one pattern of stimuli is such that others produce no perceptible reaction, the phenomenon is called "preoccupation." Instances of this characteristic of behavior are not uncommon. The "absent-minded professor" is a good illustration. This unhappy individual, who is continually getting into the most embarrassing situations, is attending so well to one part of his environment that no other part seems to have any effect on his behavior. We are all absent-minded professors whenever we are so engrossed in one activity—such as reading a book, listening to the radio, sewing, or drawing—that we fail to hear voices or note the tempera-

ture of the room, the cramp of an uncomfortable position, or that it is past lunchtime.

If certain activities are habitually practiced in certain environments, we will note that some of the extraneous stimuli become integrated into the activity in such a way that there appears to be some re-enforcement of the activity in progress. Our only response to these stimuli seems to be a continuation —perhaps even an intensification—of what we are doing. Some students claim that they study best when the radio is turned on; others must have quiet. Some work best in their own rooms; others find the library more satisfactory. Within limits, just which of these conditions will produce the most satisfactory output is a highly individual matter. It might be said in passing, however, that the claim made by some students that the radio must be on for their best work is frequently nothing more than an excuse to have it on. Usually, such students do not do an especially good job with the radio either on or off, and so it does not make much difference. Some work has been done to show that, although you may do more and even better work under conditions in which many outside stimuli are competing for your attention, you expend more energy in accomplishing your task. Your muscles are more tense; you grasp your pencil more tightly and in other ways engage in excessive activities. THUS, YOU SEE, YOU ARE RESPONDING TO THE EXTRANEOUS STIMULI, BUT THE RESPONSE IS INTEGRATED INTO THE ACTIVITY ALREADY IN PROGRESS.

An interesting thing happens when we alter the conditions in which certain activities are habitually performed. Suppose, for instance, we ask the student who studies with the radio turned on to try working without the radio. He will be considerably disturbed, just as the student who has been in the habit of studying in more quiet surroundings will be bothered when we ask him to try working with the radio on. Almost any disturbance of this character will produce marked effects in the efficiency of the performance. This is further evidence that the extraneous stimuli had been incorporated into the original surroundings and were being responded to in terms of the activity then in progress. This might give us the basis

for a definition of a *distraction.* We could define a *distraction* as *any new stimulus,* but such a definition must be further qualified.

Suggestion and suggestibility

Another matter relating to the efficiency of attention lies in the fact that, UNDER CERTAIN CONDITIONS, THE COMPLETENESS OF THE RESPONSE IS MUCH GREATER THAN WE WOULD EXPECT WERE WE TO PREDICT IT FROM A KNOWLEDGE OF THE STIMULATING PATTERN ALONE. STIMULI PRODUCING THIS EFFECT ARE CALLED "SUGGESTIONS." A FURTHER CHARACTERISTIC OF A SUGGESTION IS THAT IT WAS ONCE PART OF A LARGER STIMULATING PATTERN. The response made to suggestion is the response that was originally made to the larger pattern of which the suggestion was then a part. The phenomenon is sometimes referred to as *redintegration,* or *perceptual filling.* It is somewhat the same thing that most of us refer to when we use the term *association.* Although association does not have exactly the same meaning, it does bring out the importance of previous experience in determining just what the response will be. Many people have been "shocked" by bared electric wires in which there was no current, "burned" by objects that looked as though they should be hot but were not, "hurt" by objects that "looked" painful.

The moving pictures furnish us with an excellent illustration of suggestion at work. As you know, nothing moves in a "moving" picture. If you hold a strip of film up to the light, you will see a series of still pictures, each of which shows the objects in a slightly different position. When these still pictures are shown in fairly rapid succession, the objects pictured appear to move. The movement is not jerky or unnatural. If a person in the picture moves from one side of the screen to the other, we see the movement as a smooth progression; we see the image at the beginning, at the end, and in all of the intermediate positions. Now, of course, by showing the pictures one at a time, you could demonstrate that we saw the person at places where there was actually no image. In other words, we were "seeing things." But the experience seemed

perfectly natural. Whenever a person has been seen here, here, and here in rapid succession, he has always been in between these positions also; and so we "see" him, although actually he is not there to be seen. This illustration brings out all of the important aspects of the phenomenon of suggestion: The stimulus is a part stimulus; certain details are missing. The reaction is as though the missing parts were there, and the whole effect is determined by the fact that the organism has experienced the total situation some time before.

The illustration of the moving picture was used here, rather than some unusual illusion, to remind you of the fact that it is perfectly "natural" for people to behave in this way. The "unnatural" thing to do in a theater would be to see the images on the screen *only* in those places and positions in which they were actually projected. We can begin to see now why the report of a person as to what he has seen or heard or felt or tasted can legitimately be doubted until supporting evidence is furnished. If the attention, or set, of the moment is just right, your report of what you have seen or heard may only remotely resemble the actual event. The fact that you are "absolutely sure," or that you will swear to the truth of your observations, is still no assurance of accuracy. This is a bitter pill for most of us to swallow. To have our own eyewitness accounts questioned is most irksome, to say the least. And yet, you were sure that you saw the objects move on the screen in the theater, were you not? You did not leave the theater saying that you enjoyed the "apparent-moving" picture!

"SUGGESTIBILITY" IS THE READINESS WITH WHICH AN INDIVIDUAL WILL FILL IN THE MISSING DETAILS THAT ARE ABSENT FROM THE SUGGESTION. When we speak of a person as being "suggestible," most of us mean simply that, with very little to go on, such an individual reports seeing, tasting, and feeling things that we know are not present. Some people, before an open window, will feel a draft when the air is absolutely still; some will taste salt in food that has not been seasoned; some, on the basis of rumor, will report a whole series of incidents that we have every reason to believe are real to them.

When we speak of a person as being "suggestible," however, we must always qualify it with a statement as to which suggestions are most effective. Suggestibility is not a *generalized* personality trait. It applies only to specific aspects of the behavior of a given individual. All individuals are suggestible to some extent.

Hypnosis

The dependence of suggestibility upon the background of the individual and the particular set of the moment is dramatically illustrated in the phenomena of *hypnosis*. "HYPNOSIS" IS A STATE OF HEIGHTENED SUGGESTIBILITY ACCOMPLISHED BY NARROWING THE RANGE OF STIMULI TO WHICH THE INDIVIDUAL MAY RESPOND. Under these conditions, and with careful instruction, we can produce behavior that is not usually possible because of the conflicting demands of the environment upon the organism.

One unique condition prevailing during hypnosis has given rise to considerable hocus-pocus in the practice of hypnotic induction. This is the relationship that obtains between the "hypnotized" and the "hypnotizer," the latter being more frequently designated the "operator." It happens that, when one is preoccupied under the conditions described above, he does not have the inhibitions produced by a variety of stimuli, and will therefore carry out the commands or suggestions of the operator more completely than he could, or would, if other extraneous stimuli were not present.

Hypnosis not magic. This perfectly natural fact has given rise to the notion that some peculiar relation exists between the two persons involved in a hypnotic experiment. This condition is technically designated as *rapport*. In itself, this is nothing strange, peculiar, or unique. Every effective public speaker and every successful actor must establish rapport between himself and his audience. The induction of hypnosis is very similar to the salesman's "development" of a client. The salesman also is attempting to establish rapport. The technique of "getting over" is a matter of a knowledge of the

specific conditions involved, and need not be considered further at this point.

In the very early practice of hypnotism, as practiced by Mesmer and his disciples, this rapport was considered to be an attraction called by them "animal magnetism," from its analogy to "metallic magnetism," which, during Mesmer's activities in Paris, was a popular plaything. In order for this animal magnetism to pass from one person to another, it was supposed to be necessary that they make actual physical contact. Later, development of the technique by vaudeville performers has permitted passing of the hands before the eyes and a muttered gibberish with the same effect. Modern laboratory procedure frequently substitutes a victrola record for the personal operator.

Thus, we see that animal magnetism is in the same category as stellar influence over human destiny; but, as with other magical practices, some people still insist today that magical rites are highly efficacious, and wear belts containing magnets as a cure for rheumatism or an asafetida bag around the neck as a protection against colds. In other words, hypnosis as practiced publicly for entertainment is as different from the practice of hypnosis in the laboratory as alchemy is different from modern chemistry.

It is true that a commanding or prepossessing appearance is convenient in the practice of hypnotism, but in the same fashion that it is convenient in any other practice. It is also true that a beginner will have little success in hypnotizing his own friends or family, but what prophet is not without honor in his own country? Even a practicing physician rarely treats his own family and, in some states, is enjoined by law from doing so.

Hypnotizer not important. Another popular misconception with regard to hypnosis involves the assumption that the operator must be a "strong-willed" individual and that the subject must be relatively "weaker-willed." This assumption is entirely without foundation. As a matter of fact, if the subject is willing, practically any normal adult may be hypnotized by the procedure outlined above or by various other

techniques involving the same principles. Young children, animals, the feeble-minded, and so forth, cannot be hypnotized because they cannot attend to one thing long enough for their activities to become restricted.

Another misconception regards the appearance of supernatural powers on the part of hypnotized subjects. Upon the proper suggestion, the hypnotized subject will raise his arm above his head and hold it there much longer than the nonhypnotized subject is able to do; but this merely means that he is not attending to the sensations of fatigue that arise from this arm, just as we, in normal situations, may read an exciting story or attend a play without realizing that our foot has gone to sleep. The ability to discriminate in hypnosis and nonhypnosis has been investigated experimentally, and it has been found that the hypnotized subject can make no finer discriminations than any attentive, intelligent individual who works hard enough at the task.

The fact that it can be suggested to the hypnotized subject that he is not able to feel pain and that, consequently, he will not feel any led to an early development of the technique of hypnosis in major and minor operations. This development occurred largely in France, prior to the discovery of general anesthesia. The technique of general ether anesthesia is so much more controllable than the technique of hypnosis that the latter has been almost superseded in modern surgical usage.

An experiment in hypnotic suggestion. Hypnotized subjects are supposed to carry out the suggestions given them during hypnosis more completely than nonhypnotized subjects are able to do. One investigator[2] has experimented on this phase of the general problem. To a nonhypnotized group of subjects, it was suggested in the ordinary fashion that they breathe twice as fast on the even-numbered pages of a book they were reading as on the odd. To the experimental group, the same suggestion was given during hypnosis. The subjects were tested at various intervals from fifteen minutes to ninety

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[2] Kellogg, E. R., "The Duration and Effects of Post-hypnotic Suggestion," in *Journal of Experimental Psychology* (1929), Vol. XII, pp. 502–514.

days after the suggestion had been given. The tests were made by getting breathing records of the subjects.

Six of the eight experimental subjects were never aware, during the whole experiment, that they were breathing faster on alternate pages. The control group (nonhypnotized), of course, knew that they were carrying out the directions; and as a result of this fact, they became more proficient as time went on. On the other hand, the experimental group, although showing a slight increase in efficiency as a result of continued practice, in general did not carry out the instructions as well as the control group. Even after ninety days, however, there was some difference in the breathing records between the alternate pages.

Therefore, it was concluded that there is a low order of obedience to hypnotic suggestion for an indefinite length of time. This experiment illustrates that it is possible to experiment with hypnosis in the same way that one can experiment with any other psychological phenomenon, and that it is unnecessary and unwise to use spectacular procedures.

The range of attention

A question that is universally asked is: "HOW MANY THINGS CAN BE ATTENDED TO AT ONE TIME?" THE ANSWER IS: "ONE OR MANY, DEPENDING UPON WHAT YOU MEAN BY 'THINGS' AND 'AT ONE TIME.' "

For experimental investigation, an exposure apparatus similar to the one shown in Figure 41 has been used. The subject rests his head against the hood shown at the lower left end. The inside of the box is dark, save for a pinhole in the card at the opposite end. This pin point of light serves as a fixation point at the correct distance. On the card are the materials to be observed. When the shutter opens for one tenth of a second, too brief for scanning the card, the material is illuminated by the lamp.

Under these conditions, it was found that the threshold, or *limen* (the point at which the number was reported correctly fifty per cent of the time), was 11.3 dots for one subject, 6.2 dots for another, and 9.2 dots for a third subject. On the other hand, when the same three subjects were required to

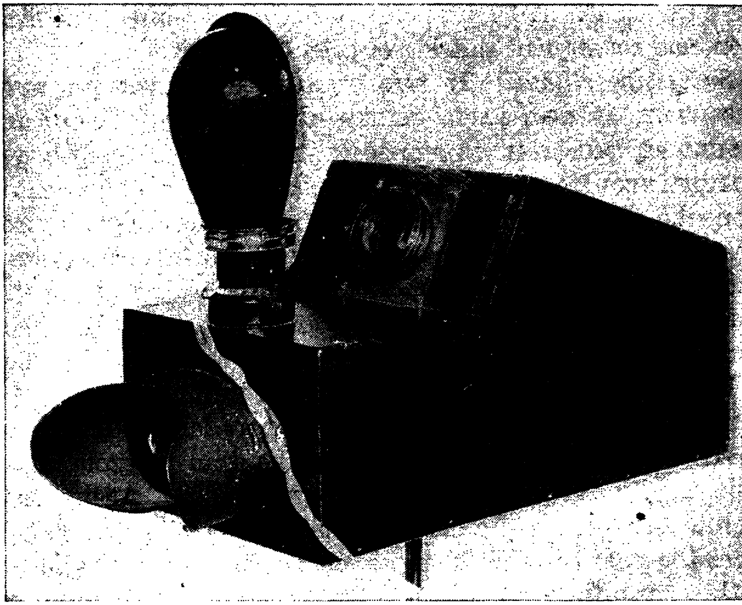

FIGURE 41.—ONE TYPE OF TACHISTOSCOPE. The subject sits with his head against the headrest and fixates a pinhole in the card inserted at the opposite end. The experimenter operates the camera shutter, which may be set for an exposure of from 1/100 second to ½ second. When the shutter is open, light from the lamp illuminates the material printed on the card. (*C. H. Stoelting Company.*)

name letters, the thresholds fell to 7.9, 6.9, and 5.9 letters, respectively. When geometric forms were named, the thresholds were 4.3, 3.2, and 3.9 forms for the respective subjects. Finally, when they were required to describe similar forms, the thresholds were 3.3, 3.0, and 3.3 forms. In other words, the more complex the task required, the fewer were the discrete elements that could be observed during the period of exposure.[3] You will also note that "at one time" here was taken to mean one tenth of a second. It would not be too difficult to predict the general trend of the results had the time been one hundredth or one thousandth of a second, or longer. One tenth of a second is short enough to prevent eye movement or attending to several aspects of the exposed material. A shorter exposure would give the same results provided the illumination

[3] Glanville, A. Douglas, and Dallenbach, K. M., "The Range of Attention," in *American Journal of Psychology* (1929), Vol. LXIV, pp. 207-236.

were sufficient. A longer period would allow shifting of fixation, and consequent shifting of attention.

Successive stimuli. IF THE STIMULI ARE PRESENTED SUCCESSIVELY, AS THE RAPID CLICKS OF A TELEGRAPH SOUNDER WOULD BE, THE RESULTS ARE SOMEWHAT THE SAME AS WITH SIMULTANEOUSLY PRESENTED MATERIAL. In a slow presentation, the subjects count the clicks; but if the clicks are presented too rapidly for counting, a grouping of the clicks is relied upon, even though the clicks themselves are evenly spaced. With a little practice, the size of the groups may be still further extended.

If the clicks are presented in groups or in some rhythm, the subject soon acquires the ability to report large numbers of clicks. The possibility of increasing the span by grouping is illustrated in the learning of the telegraph code. At first, the learner must count the clicks for each letter; then he recognizes the pattern of clicks representing each letter as a letter without counting; and finally word patterns, and even phrase patterns, are acquired.[4]

Subjects report that the dots or other material are always organized into a group or pattern. This is further demonstrated when the letters form words. The number of letters in this case is almost unlimited if the words are familiar. The development of organization into patterns is illustrated by a person learning to drive a car. At first, attention shifts from one control to another. At an intersection, he *looks* to the right, then to the left, and neglects what is in front or behind him. The experienced driver *sees* the traffic in front, at the sides, and in the rear-view mirror as one unit.

The duration of attention

Students often complain that, in spite of having spent two hours in study of their assignment, they have failed to get it. When they have been urged to analyze the situation, they admit that they have not been attending to the subject matter

[4] Bryan, W. L., and Harter, N., "Studies in Telegraphic Language," in *Psychological Review* (1899), Vol. VI, pp. 345–357. This is one of the classics in experimental psychology.

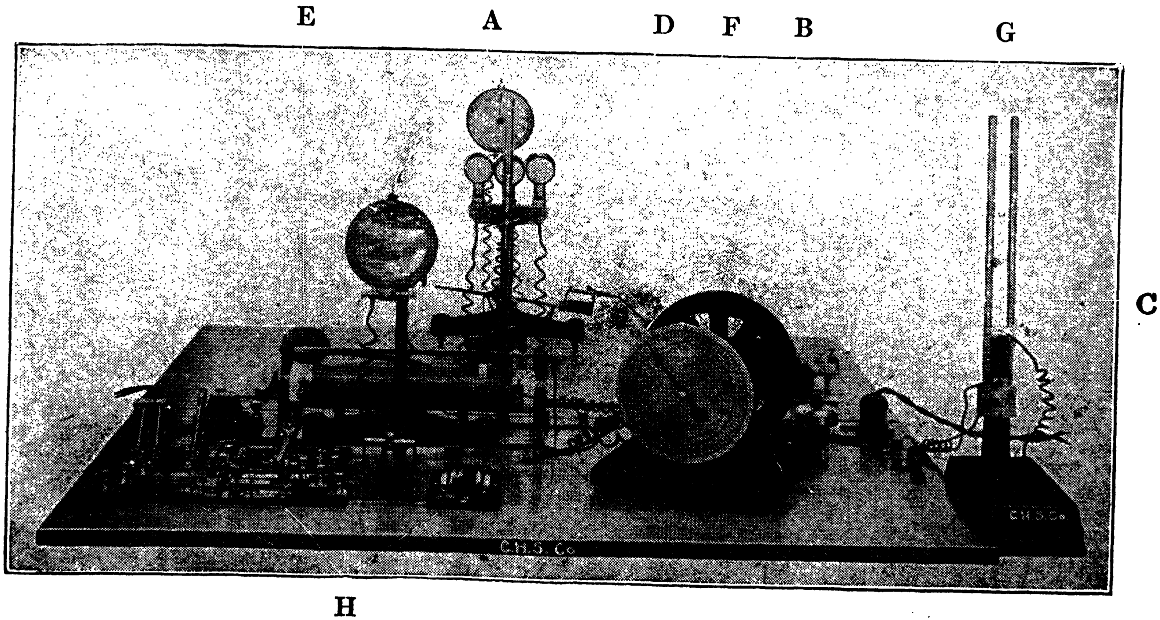

Figure 42.—The Dunlap Chronoscope and Accessories for Determining Reaction Times. *A*, voice keys; *B*, chronoscope; *C*, electric tuning fork for control of the chronoscope; *D*, three-lamp visual stimulus; *E*, pneumatic reaction key; *F*, tactual stimulus key; *G*, telegraph sounder for auditory stimulus; *H*, control switches. (*C. H. Stoelting Co.*)

for more than a few minutes at a time. HOW LONG WE CAN ATTEND DEPENDS UPON WHAT DEGREE OF ATTENTION IS REQUIRED AND ALSO UPON ALL OF THE CONDITIONS OF ATTENTION. If a student's desk is littered with numerous objects that are not related to the subject—such as a picture of his girl, a program of a dance, a nail file—these are distracting stimuli. The fact that the subject of study is new and that he has not yet mas-

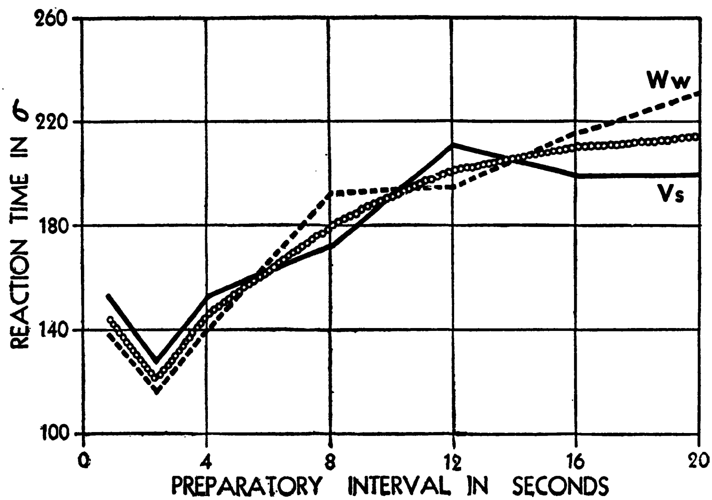

FIGURE 43.—THE VARIATION IN THE INCREASE IN REACTION TIME WITH INCREASE IN THE DURATION OF THE PREPARATORY INTERVAL. The broken-line curve and the heavy-line curve represent the results experimentally obtained with subjects *Ww* and *Vs*. The circle curve represents the average for the two subjects. The abscissae represent the duration of the preparatory interval, while the ordinates represent the reaction times. $\sigma = .001$ second. (*Woodrow, p. 87.*)

tered its vocabulary or does not recognize any clear value of the course in his life also are conditions militating against attention to the subject. If the subject is more familiar to him, the distracting objects on his table are replaced by materials needed in his study; he may work, uninterrupted, for several hours.

The degree of attention is illustrated in a reaction-time experiment: [5] The apparatus consists of a chronoscope, which records in thousandths of a second, and accessories (Figure 42).

[5] Woodrow, H., *The Measurement of Attention,* Psychology Monographs, No. 5 (1914), Vol. XVII.

When the experimenter presses a key, a stimulus is presented, and simultaneously the chronoscope starts. The subject's reaction stops the chronoscope. In order to ensure the maximum set to react, the subject receives a warning signal before the stimulus is given. In this experiment, the interval between the warning signal and the stimulus was varied from half a second to twenty seconds. Figure 43 shows the results for two subjects. It is valid to assume that the shortest reaction time represents the highest degree of attention. It was found that a two-second preparatory interval was most favorable to the shortest reaction time. In other words, there is a latent period of two seconds before attention reaches its maximum.

We see, therefore, that how long one may attend depends, not only upon the conditions favorable to attention, but also upon the degree of attention that is demanded. We might say that, in the reaction-time experiment, two to four seconds represented the duration of good attention. With other material and with less demand upon attention, the period might be of some other length.

Shifting attention

Some people can shift from one task to another with apparent ease. For others, such shifts are disastrous, because the lag in getting started on a new task is too great. This is possibly one reason why some students fail in their work when they get involved in too many outside activities, while others seem to thrive on such diversity. Some individuals fail to make good executives for this reason.

The difficulty of shifting attention is illustrated by a simple experiment:[6] Twenty-five simple problems each of addition, subtraction, multiplication, and division were presented to college students. In one test, each set of problems was in a separate column. In another test, the problems were in random order. When the problems were in separate columns, the average time required for the total 100 problems was 159.3

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[6] Dashiell, J. F., *Fundamentals of Objective Psychology* (New York: Houghton Mifflin, 1928), pp. 281–282.

seconds. In the mixed order, an average of 181.7 seconds was required. It would be interesting to test the hypothesis stated above by giving this test to two groups: those who seem able to carry on many activities, and those who bog down as soon as a multiplicity of tasks is required.

Fatigue

Experimental investigations of "mental fatigue" have produced interesting results. We are inclined to lay great stress on fatigue as a cause of our inability to accomplish the task in hand. You are too tired to study tonight. The theme that must be written is put off until you feel fresh. NEVERTHELESS,

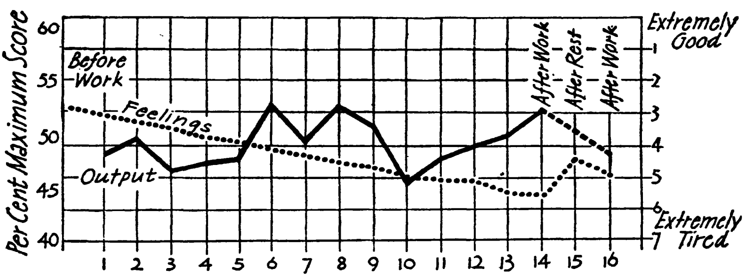


FIGURE 44.—CURVES OF THE FEELINGS OF FATIGUE (DOTTED LINE) AND OF ACTUAL OUTPUT. (*Poffenberger.*)

OUR FEELING OF FATIGUE AND OUR ABILITY TO WORK ARE NOT ALWAYS CORRELATED.

When one is instructed to add columns of figures as rapidly and accurately as possible for several hours, he will show little decrement in either speed or accuracy, but he will "feel" fatigued. Figure 44 gives the results of such an experiment.[7] At regular intervals, the subjects rated their feelings of fatigue. It will be seen that their output fluctuated but remained as high at the end of the period as at the beginning.

Blocking

If you observe an amateur typist, and compare her with a professional, you may observe that the amateur is very irregular. She speeds up, then comes to an abrupt stop. When

[7] Poffenberger, A. T., *Applied Psychology* (New York: Appleton-Century Company, 1927).

she types too rapidly, the whole process seems to be blocked.

In a series of experiments[8] with fifty advanced college students, they were asigned several tasks, including adding, color naming, substitutions, and naming opposites. The time and errors were recorded on a moving paper. The blocks, or pauses, occurred fairly regularly on an average of three per minute, although there were individual differences. Practice tended to decrease and fatigue to increase the number of pauses. In one hour of intensive application to the task, there was no decrease in the work done per minute, although the regularity decreased. As the pauses increased, the work was speeded up between pauses. This may explain why such "work curves," as the one shown in Figure 44, do not display a work decrement. **When you are responding above a certain optimum speed, slight variations in the past performances interfere with the rhythm of the total response, causing complete momentary blocking.**

Diurnal variations

Efficiency seems to vary at different hours through the day, although here again it does not conform to what might be expected or to the reports of feelings of fitness as expressed by the subject. If one is active throughout the day, one might expect that his efficiency would steadily diminish. Table VIII indicates the variations in the efficiency of school children in several tasks. The efficiency from nine to ten o'clock is taken as the standard. It will be seen that, on the whole, children accomplish slightly more work each hour up to noon. The greatest drop comes at one o'clock; but they are nearly back to the maximum efficiency by three o'clock. It may be that the approach of closing time is an incentive to increased effort, and that at eight o'clock and one o'clock they are not yet thoroughly at work.

Using a complex task that involved making several discriminations continuously for twenty minutes, one subject was tested for several days. He was a very persistent worker on a regular schedule every day. He believed that he was a

[8] Bills, A. G., "Blocking: A New Principle of Mental Fatigue," in *American Journal of Psychology* (1931), Vol. LXIII, pp. 230–245.

morning worker and did his best work immediately after breakfast, "while he was fresh." It will be seen (Table IX)

TABLE VIII

AVERAGE VARIATION IN EFFICIENCY DURING THE DAY FOR 240 PUPILS IN GRADES 5 AND 6*

(The achievements at the several hours are proportional to that at 9 to 10 A.M., which is considered 100 per cent in each case.)

Performance Tested	*9 to 10 A.M.*	*10 to 11 A.M.*	*11 to 12 A.M.*	*12 to 1 P.M.*	*1 to 2 P.M.*	*2 to 3 P.M.*
Addition	100.0	102.4	104.2	....	102.3	103.0
Multiplication	100.0	101.9	105.1	....	100.9	103.0
Memory for auditory digits	100.0	105.9	106.7	....	99.4	102.4
Memory for visual digits	100.0	103.2	109.2	....	99.1	103.4
Recognition of nonsense syllables	100.0	104.7	105.3	....	100.0	103.7
Completion	100.0	105.0	109.7	....	106.2	108.8
Average	100.0	103.8	106.7	....	101.3	104.1

* Gates, A. I., *Psychology for Students of Education* (New York: The Macmillan Company, 1923), p. 384.

TABLE IX

EFFICIENCY VARIATIONS DURING THE DAY FOR ONE SUBJECT

(The score at 8:00 A.M. o'clock is taken as the standard. In case no test was given at 8:00, the per cent is based on the mean of the two nearest days.)

Day	*8 A.M.*	*11 A.M.*	*1 P.M.*	*4:30 P.M.*	*9 P.M.*
1	100	111	94	137	
2	100			107	
3	100			81	
4				69	
5	100			173	
6		166		125	
7		139	77		
8	100	133	70	122	109
9		120	75	138	134
10	100				
11	100		114	114	94
12	100	95	102	99	101
13	100	105	78	108	
14	100	111	80	113	
15	100	107	61	95	75
16	100		91	53	
Total	100	121	83	113	103

that his variations in efficiency somewhat parallel those of the school children.

Summary

What we observe or how we react depends upon the interaction of a multiplicity of factors, part of which can be attributed to the varying conditions within the individual himself and part to the ever-changing conditions of his environment. *Set* and *posture* are two terms that refer to the momentary response and readiness of the organism. Your habits, interests, and immediately preceding activities determine, not only what you will observe in your environment, but how you will deal with these environmental influences.

These same factors also determine what we have called *suggestibility*. A heightened degree of suggestibility is attained when the factors contributing to one specific set predominate in an unusual degree. Hypnosis, when it is thus understood, loses its mystical character, although it remains a no less interesting and instructive phenomenon.

Equally important are the so-called *range* and *duration of attention*. With the onset of fatigue, the range of objects included in the pattern to which we respond becomes more limited. The auto driver becomes more accident-prone for this reason. In hypnosis, the field of activity is limited, because some stimuli are not effective in eliciting a response. Hence, in the narrower field, we may say that the hypnotized subject is more highly "attentive" than he would be if not hypnotized.

Our "interests" represent our specific sets or postures. But these interests are the result of our preceding activities and the influences of our environment. A professor "makes a course interesting" if he furnishes the social stimuli that coordinate with your habits and activities. You find certain courses interesting because of what your life contributes. The fact that a certain course is not interesting is not due to the professor or to the subject matter alone.

11

Perceiving

Factors in Discrimination

In Chapter II, we briefly described the receptors that furnish our contact with the environment. We have also emphasized the importance of reactions as one method of adjusting to and controlling the environment. It should not be assumed, however, that behavior consists of a mere summation of a multiplicity of stimuli and discrete responses to each stimulus. You do not respond to a tone as a stimulus of so many vibrations per second. The tone is a part of a complex of stimuli, other tones and noises, lights, shadows, odors, and so forth. Furthermore, your posture at the moment, your previous experiences, and your capacity for attending all play a part in your perceiving of the tone.

As you look at your desk, every object on it is stimulating your retina. Yet, you do not "see" the note someone has left for you; nor do you "see" that a book is missing. You observe the desk and its contents as a whole. The individual stimuli are a part of the whole mass of stimuli. Each adds its influence, but if you could isolate any one stimulus, it would be a very different thing from what it is as a part of the total complex.

Wholes and parts

We can understand more clearly the nature of the processes involved in observing if we study a few simple examples of it.

Patterns. If we look at Figure 45 A, we notice that some of the dots seem to form groups more readily than others. This is true because they are closer together in space or because they seem to make a pattern that is easily observed. Which dots

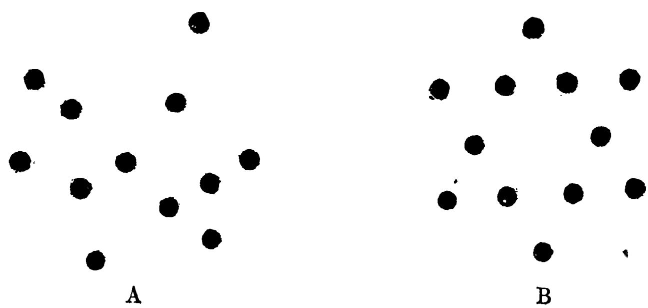


FIGURE 45.—DOTS ARE SEEN AS GROUPS.

seem to us to constitute a group or what pattern they fall into depends, not only upon their arrangement, but upon how this arrangement fits in with our way of observing. In other words, our previous experiences with such forms affect our observation. Sometimes the pattern of dots may be so definite

FIGURE 46.

that, even though the dots are discontinuous, separate elements, they are seen as a pattern. For example, in Figure 45 B, the dots are seen as constituting a star. It is not necessary to draw lines between the dots to make this clear; they "naturally" fall into such a pattern. Another illustration of the fact that we fill in the elements in a pattern is found by looking at Figure 46. Although only a few of the elements of the outline are given, we fill in the complete outline, making a human figure.

FIGURE 47.—THE FACES IN A FLOWER.

Familiarity. We have learned that some things go together to constitute a unit. Thus, it would be easy at a glance to recognize the words "United States" as a unit, although these are two words with a total of twelve letters. We "see" it as a single object. If the constituent letters were printed without reference to any order, a single glance would at best reveal only five or six letters. A similar phenomenon may be observed in looking for the hidden faces in puzzle pictures (Figure 47). Face forms are so familiar that it is easy to see the outlines of a face in branches and leaves when this is what we are looking for. We also see pictures of familiar objects in clouds and in ink blots. Another element that enters into the solution of the puzzle picture is the fact that we assume a sort of set, or readiness, to find the picture.

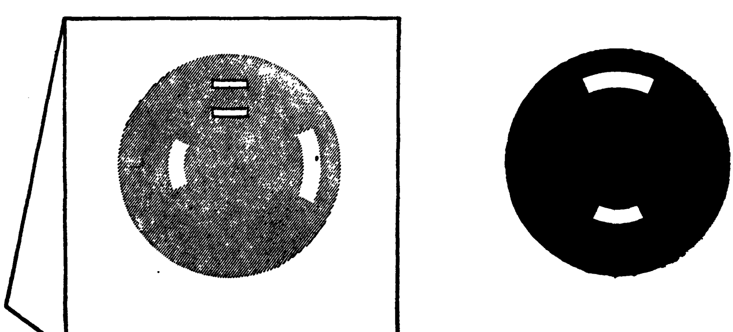
All of these cases merely illustrate the fact that what we "see" is determined by the total arrangement of objects in the field of vision and by the experience or degree of familiarity we have with certain other arrangements. A diagonal, a circle, a star, and the outlines of a face are all familiar. If dots or lines can be drawn together into a complete familiar whole, we readily see this pattern. We do not necessarily build up patterns from simple elements. In many cases, we learn patterns first and analyze them afterward. A child or an infant

sees faces about him. He also hears sounds emanating from objects. He touches and feels many of these objects, and in other ways reacts to them. In this way, he builds up specific reaction patterns, which he is taught to call *mother, father, bottle,* and so forth, without any reference to the specific elements that enter into each.

In other words, many things are learned as wholes and only later analyzed. When the novice unfamiliar with the workings of an automobile engine is in trouble for the first time and lifts the hood, he is nonplused by the fact that he can see nothing but an engine. To the expert, there are a carburetor, a distributor, spark plugs, cables, and many other elements, each of which he sees in turn. When we look at a painting hanging in an art gallery, we see just a picture that is pleasing or otherwise. If we become more familiar with the principles of art, or if we study this particular picture for a certain period, little by little its constituent elements become clearer and clearer to us.

Seen movement

Another interesting illustration of the fact that we perceive the whole or organize the parts into a complete picture may be found in motion pictures. If we observe a man walking down the street, we can see that he is swinging his arms rhythmically, that his legs move in quite smooth cadence, and that



A B

FIGURE 48.—APPARATUS FOR DEMONSTRATING SEEN MOVEMENT.

he is progressing forward at a uniform rate. In the motion picture, we see a reproduction of this activity; yet "motion" pictures do not move. They are simply a series of snapshots exposed at the rate of from sixteen to twenty-eight per second. When the first picture is exposed, we start to react to it; but

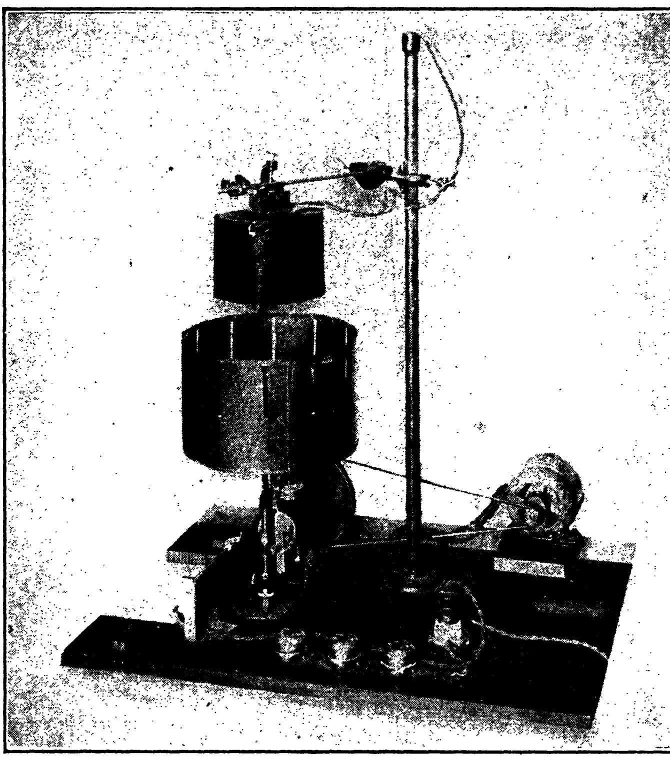


FIGURE 49.—ONE FORM OF STROBOSCOPE.

before we recognize it fully, the second picture is shown, and then the third, and so on. *We* move on from one picture to another. Thus, the movement consists of our continuous reaction to the series of pictures.

This principle can be shown in the laboratory. Two small holes are cut about an inch apart in a gray screen (see Figure 48 A). Behind these, the disc *B* is rotated so that white is exposed at one hole while black is exposed at the other. As

the white spot thus alternates from one hole to the other, it will appear, at the proper speed of exposure, to "move" across the intervening space. This illusion of movement was discovered long before the popular movie came into existence. It was presented in the form of the *stroboscope* (see Figure 49). If a sequence of slightly different figures is placed opposite each slit and the drum is rotated, by looking through the slits as the figures pass the eye, one sees a uniform movement of the object represented.

Perceiving as organized response

What we observe or perceive through the eye or the ear, or other receptors, is determined by the organization of behavior we have been able to acquire. It is sometimes said that, to the infant, the world is merely a buzzing confusion. It would perhaps be better to say that for the infant the outer world is nothing in particular. The buzzing confusion occurs later under special circumstances, which we may represent as a disorganization of response. The infant's reactions at first are what we have called *random responses,* out of which, little by little, he learns to react specifically to specific situations. This development of specificity of response is what we term *organization.* We see and hear what we have learned through long experience to respond to in specific ways. The novice does not see the carburetor in the automobile. The man who is unfamiliar or inexperienced with outdoor life does not see or hear what the naturalist or woodsman sees and hears. He is untrained to make the kind of responses to these situations that the one familiar with them makes. We may say that his receptors or sense organs are being stimulated, but that the data from these receptors are not organized into any specific response that can be identified with any specific stimulus. The botanist can observe variations in the plant life along the trail that his companion passes by unnoticed. "OBSERVATION," OR "PERCEPTION," THEN, IS THE ORGANIZATION OF DATA, IN THE SENSE THAT WHAT IS GIVEN THROUGH RECEPTORS IS ORGANIZED INTO A PATTERN OF RESPONSE.

Analysis of perception

While it is true that our behavior is governed by a pattern of stimuli that includes all the stimuli, both internal and external, affecting the organism at any particular moment, it is possible to analyze the various elements that are most important in the make-up of perception. These data may be conveniently classified as:

1. The sensory data from the object and its background.
2. Previous sensory data and previous reactions.
3. The reaction of the organism with reference to the stimuli presented.

1. *Sensory data.* If you are asked to list the sensory data that you derive from seeing a book upon the table, you might first say that the book is red. Color is one of the elements. But the color varies in hue, saturation, and brightness, owing partly to the texture of the book's surface and partly to the angle from which you view it. Also, a certain area in the retina is stimulated. This is all the visual impression you receive. You say that the book is bound in a closely woven cloth, and that it is rather heavy; but you do not receive the perception of texture and weight *directly* through the visual receptors. All that you receive directly through vision must be in terms of the visual properties of hue, saturation, and brightness, and of the pattern of distribution over the retina. Each visual impression lasts a definite length of time, so that it may also be said to have the property of *duration.*

2. *Previous data.* Further investigation will reveal that this book, or similar books, and other objects have been seen before. These objects have been touched, handled, read, smelled, and, where possible, tasted, and the impressions obtained from these experiences have involved other receptors beside the visual. You "see" that the book is heavy because of previous kinesthetic and tactual impressions. You "see" that it is rough because the particular visual impression has been experienced with the tactual impressions of roughness. The light reflected from the surface is similar to that which has come from rough objects before.

Thus, we find that previous experiences have become organized to such an extent that it is difficult to analyze the separate elements. This fact is particularly evident in the case of vision. All sorts of characteristics are ascribed to visual impressions. What is true for vision is likewise true for every other sense department—for example, in the case of "tastes," which are a combination of gustatory and olfactory, tactual, and temperature impressions. It is erroneously believed that the whole combination is a matter of simple gustatory reactions. Other perceptions involving combinations of the various sense departments will occur to the student.

As a matter of fact, these experiences have occurred so many times in the history of the individual that it is not exactly descriptive of the actual conditions to speak of the "combination" of various sense departments. These sense departments are more intimately related than the word *combination* intimates. It is only when we stop to analyze the situation that we conclude that weight and texture are not essentially of a visual nature but must have been conditioned with strictly visual stimuli.

Our ability to separate a common "taste"—such as the taste, or flavor, of coffee—into its strictly gustatory, olfactory, tactual, and thermal derivatives is not as far developed as is our ability to analyze the factors in the visual field. Even after long practice, the results of such analysis are not as clear-cut as are analyses in the visual-tactual-kinesthetic field.

3. *Reactions to the situation.* In the third place, the bodily adjustments that are made with reference to the object are an integral part of the perceptual process. The more specific adjustments may include that of the sense organs concerned. In the case of our illustration, the turning of the eyes, which gives a clearer view of the object, and the focusing of the lenses are important factors. General bodily adjustments, such as a turning of the head and the contraction of muscles, are intimately associated with the object. Laryngeal movements, breathing changes, and changes in the general tonus of the whole organism form the background of the whole process.

Illusions

If two cubes, whose dimensions are respectively three and twelve inches, are of equal weight, the smaller will be estimated to be from two to five times as heavy as the larger one. This phenomenon is called the *size-weight illusion* and is a good example of the interdependence of the several factors. In this case, the kinesthetic and tactual impressions have been influenced by the visual. Smaller objects are more often lighter in everyday experience. Hence, our muscular adjustment is for a lighter weight; and, as a result, we overestimate the smaller object and likewise underestimate the larger one.

Another typical illusion is shown in Figure 50. The line *b* does not seem to be a continuation of the line *a*. If a straightedge is placed along these two lines, it will be seen that, actually, one is a continuation of the other. This phenomenon is usually explained by saying that we "overestimate" acute angles and "underestimate" obtuse angles. We can understand how this would be true if we consider the fact that we rarely see angles as they really exist. The table top is rectangular; yet from any position that you view the table, the corners are either less than or greater than right angles.

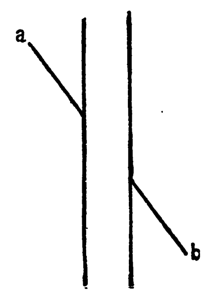


FIGURE 50.—THE ILLUSION OF THE BROKEN LINE.

Distance Discrimination

The eye is frequently called a *distance receptor* because we refer the stimulus to an object that is not in direct contact with the receptor, and because we are able to discriminate visually how far an object is from us or which of two objects is farther from or nearer to us. We are so accustomed to seeing objects that we generally fail to realize that this discrimination is a psychological problem. "We just see the object as out there," we say.

That our differential responses are "learned" may be admi-

rably illustrated by a consideration of our spatial discriminations. In those types of organized responses that are designated *perception,* not alone is the reaction made to a single stimulus acting through one sense modality, but the responses resulting from other stimuli have been conditioned to this stimulus as it occurred with these other stimuli. Thus, a brick "looks" heavy. In the process of handling bricks, we have seen them, so that, now, the visual stimulus is so definitely associated with the tactual and kinesthetic responses that we "see" it as heavy.

The substitution of one sense modality for another is particularly evident in the case of distance discrimination. That book upon the table is farther away from me than the blotter. It would require a greater movement to reach it than to reach the blotter. The accuracy of our discrimination of distance, therefore, is dependent upon a combination of factors—some of them specifically visual, some of them responses of adjustment at the moment of seeing the object, and still other responses in other sense fields that have occurred on previous occasions.

Factors in space discrimination

These include: relative size, relative distinctness, vertical position, intervening objects, shadows, and movement.

Relative size. We see familiar objects without much variation in size, regardless of the distance they are from us. Actually, the size of the image in the retina is decreased; but we have learned to interpret this change in size as a change in distance. A man looks as tall when he is twenty feet away as when he is only ten feet away. What we familiarly know as *perspective* is a good example of this fact. We represent the more distant objects in a picture by drawing them smaller than the nearer objects, and by making receding parallel lines in them converge.

Relative distinctness. Similarly, we have learned that the relative distinctness of objects furnishes a cue to their distance. Far-away objects are less distinct than near-by ones. An interesting illusion often occurs when one visits the mountains

for the first time. Objects miles away appear to be near at hand. As one becomes accustomed to the clearer atmosphere, distances take on their usual proportions. The painter makes the background in a painting appear at a greater distance by having it less distinct.

Vertical position. The arrangement of objects in the visual field is another factor that we seldom recognize and that yet

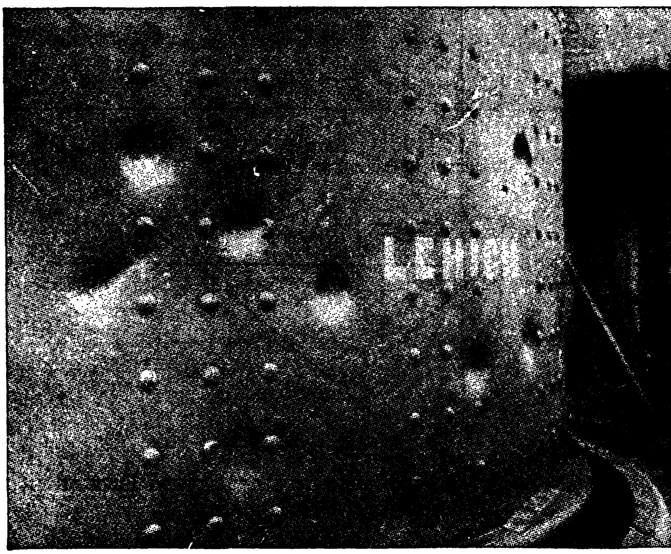


FIGURE 51.—THE INFLUENCE OF SHADOWS. (*After Titchener. C. H. Stoelting Co.*)

can be easily observed. The more distant objects below the line of the eyes are above the nearer objects, while distant objects above the line of the observer are lower than the near objects. The more distant chairs in the room are seen as above those that are nearer, and the lamps in the ceiling reverse this arrangement.

Intervening objects. This tree is nearer than that house behind it. It is 100 feet to the tree, and so forth. The importance of intervening objects is illustrated by our inability to estimate with any degree of accuracy the altitude of an airplane, as in the air it is removed from all other familiar

objects. On the deck of an ocean liner, a group of passengers were discussing the distance to another steamer. Their estimates varied from 500 feet to 2 miles. None was familiar with the size of ocean liners. The waves, the only surrounding cues, also were unfamiliar to them; hence their wide divergence in estimating the distance.

Shadows. We have learned that certain shadows are due to projections and others to depressions of the surface of the object. We know, for example, that the light falls upon the

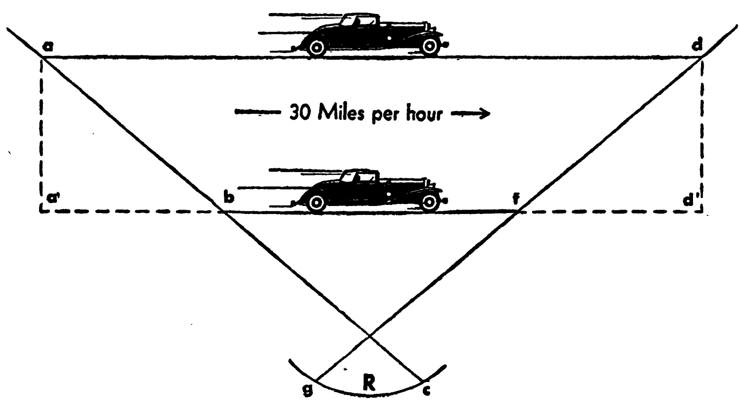


FIGURE 52.—ILLUSTRATING THE INFLUENCE OF MOVING OBJECTS IN THE DISCRIMINATION OF DISTANCE.

object from a certain direction. Therefore, the shadows indicate the projections and depressions of the object's surface. We see this effect in the illusion obtained with a picture in ambiguous perspective. In the photograph in Figure 51, depressions are seen when the picture is held in one position; but when the picture is turned upside down, these depressions appear as bulges. Most frequently, the light comes from above, and the shadows are accordingly on the under side. We interpret this picture according to such past experiences.

Movement. Moving objects close at hand pass over the field of vision more rapidly than objects at a greater distance moving at the same rate. This phenomenon is also closely related to the size of the field of vision. A train or airplane at a distance appears to move slowly because it is passing over

a greater field though the area of the retina stimulated may be the same. Speed of movement, therefore, becomes a factor in our judgment of distance (Figure 52).

Accommodation for near and distant objects

The optical mechanism has frequently been compared to the camera. In the camera, we have the sensitive photographic

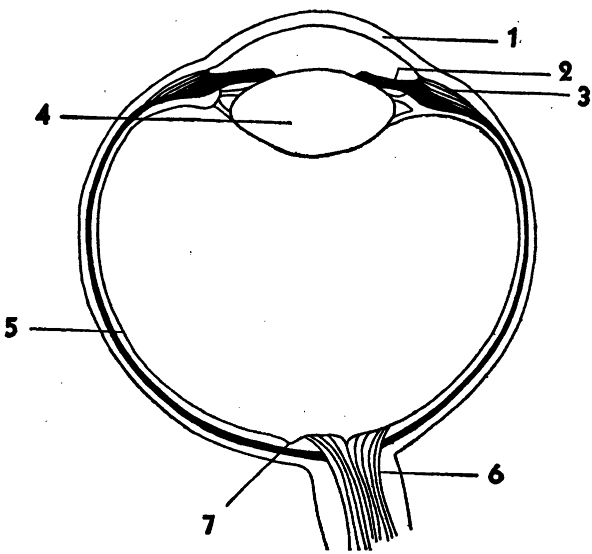


FIGURE 53.—DIAGRAM OF CROSS-SECTION OF THE HUMAN EYE. 1, cornea; 2, iris; 3, ciliary body; 4, lens; 5, retina; 6, optic nerve; 7, fovea.

film and the system of lenses that focuses the light rays sharply upon this film. If the object to be photographed is close—say, 6 feet away—the lens is drawn forward to a greater distance from the film. If the object is 20 feet away, the lens is moved toward the film. Beyond 100 feet, the distance between lens and film need not be altered. We could, of course, substitute lenses of different curvature for the various distances, but this is inconvenient.

In the eye, the *retina* corresponds to the sensitive film of the camera, and the *cornea* and *lens* to the refracting system (1 and 4, Figure 53). It is commonly assumed that the re-

fractive power of this system is altered by a change in the curvature of the lens. That would be similar to inserting into the camera lenses of different curvature. Around the lens is the *ciliary muscle* (3, Figure 53), which is attached to the edge of the lens by fine ligaments. When the muscle is relaxed, and therefore narrow in cross section, tension is exerted upon these ligaments, and the lens is drawn out flatter. This flatness would be the condition for distant vision. For near objects, the muscle contracts and allows the lens to assume its natural form of greater curvature.

When we look at a near object, we experience sensations of strain. When we have been reading for some time, we look across the room to rest our eyes. These sensations of accommodation are cues for the discrimination of distance, but they are not effective for distances much greater than twenty feet.

Convergence as a factor in distance discrimination

All of the factors enumerated thus far apply to one eye equally as well as to two eyes. However, the functioning together of the two eyes is of extreme importance. When we fixate an object with one eye, the other turns to the same point. If we fixate a distant object—say, 100 feet away—each eye is turned in toward the nose very slightly. If the object is only 10 feet away, the convergence is increased.

The movement of the eyes is controlled by a set of muscles attached to the outer coat. The contraction of the inner ones turns the eyes toward the nose; that of the outer muscles turns them in the opposite direction away from the nose. Similarly, another pair of muscles turn the eyes up or down. A third pair of muscles set at slightly oblique angles cause a rotary motion. The sensations caused by the contraction of these muscles in fixating an object furnish cues as to the distance of the object. The nearer the object, the greater is the muscle strain.

The result is a considerable improvement in discrimination over the functioning of one eye alone. If, for example (see

Figure 54), two vertical rods are set up against a uniform background 20 feet in front of the observer and one rod is slowly moved forward until he can say that it is nearer, when the observer is using only one eye, the rod must be moved 1 foot or more before this discrimination is made. With both eyes fixating the rod, a difference as small as 1 inch may be

FIGURE 54.—APPARATUS FOR MEASURING THE DISCRIMINATION OF DISTANCE.

detected. Convergence is a factor in distance discrimination up to approximately 300 feet.

Retinal disparity

The most important factor in the functioning of the eyes in the estimation of distance is the fact that what we see with one eye is not quite the same as what we see with the other. If we hold the head in one position as we look at several objects before us, first with one eye closed and then with the other closed, we can observe that the arrangement of the objects with reference to each other is not seen the same with both eyes. The stimulations fall upon noncorresponding points of the two retinas, producing *disparate images*.

The function of disparate images is illustrated nicely by the following laboratory experiment: A frustum of a pyramid is set up before the subject with the small face toward him. He makes two drawings of this frustum, side by side, with the centers of the two drawings approximately three and a half inches apart, the normal distance between the eyes. The left-

hand drawing in Figure 55 illustrates the object as the subject sees it with the left eye; the right-hand drawing, as he sees it with the right eye.

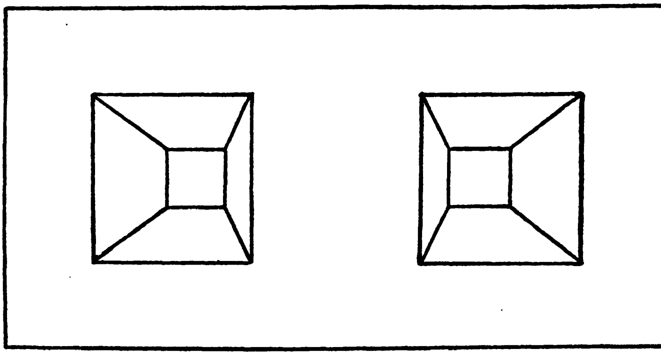


FIGURE 55.—THE TWO VIEWS OF THE FRUSTUM AS SEEN WITH THE LEFT AND THE RIGHT EYE.

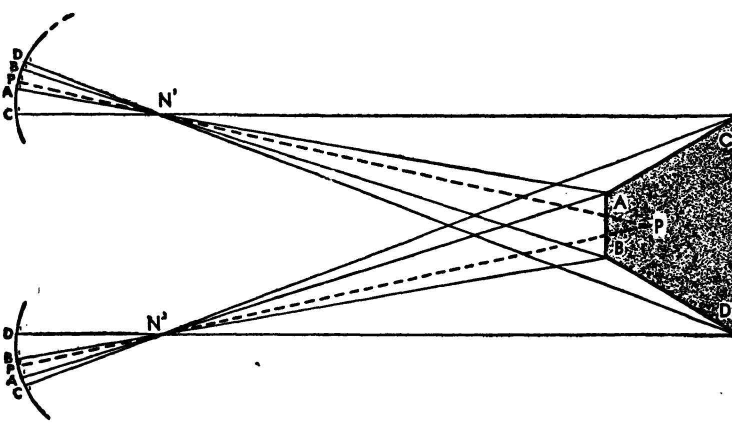


FIGURE 56.—DIAGRAM ILLUSTRATING HOW EACH EYE IS STIMULATED BY THE LIGHT FROM THE FRUSTUM. The broken lines represent the lines of regard; the unbroken lines represent rays from *A, B, C,* and *D* stimulating point A^1, B^1, C^1, and D^1 in one retina and A^1, B^1, C^1, and D^1 in the other.

If these drawings are made upon glass, the subject may fixate a distant point (100 feet) and, without changing his fixation, slip the glass up before the eyes, so that each drawing comes before the corresponding eye. Both eyes will then be stimulated as they were when looking at the original object.

With a little practice, the subject will discover that the two drawings merge into one, with the small square in front of the larger one. The appearance of depth is produced by the disparate images, in spite of the fact that the eyes are not converging as much as they would if looking at the actual object. Figures 56 and 57 show how the same stimulations are brought about in the two situations.

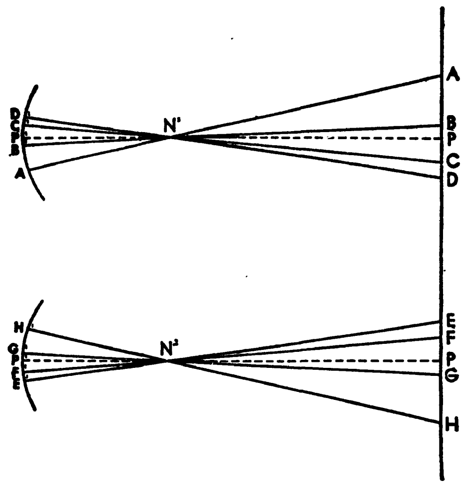


FIGURE 57.—DIAGRAM ILLUSTRATING HOW EACH RETINA IS STIMULATED BY THE DRAWINGS, AS IN FIGURE 56.

The stereoscope

If two prisms are properly placed, one before each drawing of Figure 55, the images are so deflected that the retinal points stimulated in each eye are the same ones that would be stimulated if the subject were looking at the object (Figure 58). This is the principle of the *stereoscope,* a simple little instrument that, a generation ago, was to be found on every library table (Figure 59). The stereoscopic view is made by a double camera, which photographs the scene from two slightly different angles, just as the two eyes would see it. An examination of the two pictures in Figure 60 will reveal that they are slightly different. Though either view shows depth to some extent—owing to perspective, relative clearness, shadows, and

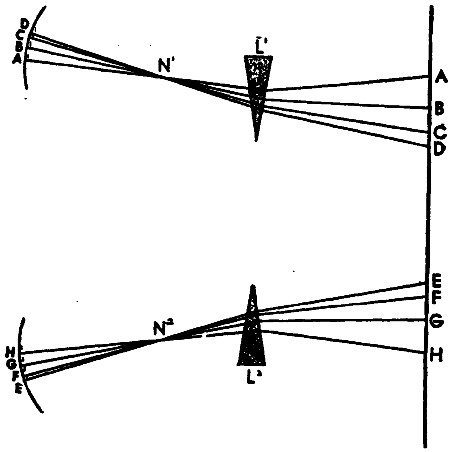


FIGURE 58.—THE FUNCTION OF THE STEREOSCOPE. The images *A*, *B*, *C*, and *D*, and *E*, *F*, *G*, and *H* are deflected by the prisms L^1 and L^2 so that the rays fall upon the same parts of the retina as in Figure 56.

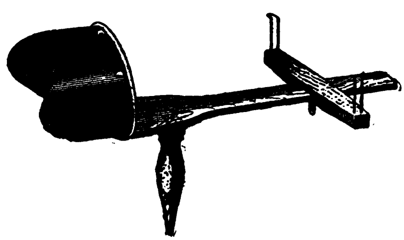


FIGURE 59.—THE STEREOSCOPE. (*C. H. Stoelting Co.*)

FIGURE 60.—A STEREOSCOPIC VIEW. (*C. H. Stoelting Co.*)

so forth—the depth of the picture is greatly increased when the double picture is viewed through the stereoscope. It is estimated that disparate images are effective in the discrimination of depth or distance up to approximately 2,500 feet from the object.

The Function of the Eyes in Reading

Reading involves a great deal more than the functions that come under the heading *sensory discrimination;* yet, the problems of clear vision, eye fatigue, and numerous types of sensory defects are so important that it is advisable to treat them in a special section. Many students find that one of their chief difficulties is either the necessity of laboring under the severe handicap of eyestrain or the inability to read all the assignments in the time at their disposal. Some of these difficulties are due to defects of the optical mechanisms, some to inadequate illumination, and still others to the fact that the student either has not learned how to read or is naturally slow in comprehension.

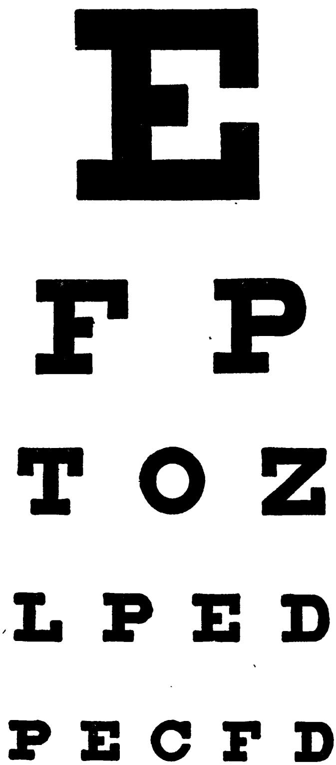


FIGURE 61.—TEST CHART. (*Modified from Snellen's.*)

Visual acuity

We have already described the mechanism (page 241) whereby a clear image is focused upon the retina. If we wish to determine the limits of distinct vision, we set up two lines or dots at a given distance from the eye and move them closer and closer together, until we discover the nearest distance between them at which we still see them as two. This *two-*

point limen is found to be such that it subtends an angle of approximately one minute. For practical purposes, test charts composed of letters are generally used. Each letter is so designed that each section of it subtends this angle when the chart is placed at the proper distance (Figure 61). It is usually convenient to set the test chart at a distance of twenty feet. If the subject can read the letters of the size that subtends an angle of one minute, and no smaller letters, he is given a rating of 20–20. If he can read only those letters at twenty feet that should be read at thirty feet, his rating is 20–30. Some individuals at a distance of twenty feet can read letters that at ten feet subtend an angle of one minute, thus securing a rating of 20–10.

Defects of vision

Inability to read letters at the normal distance may be due to the fact that the curvature of the surfaces of the lens and the cornea is too great and the rays come to a focus in front of the retina, producing *myopia,* or *nearsightedness.* On the other hand, the curvature may be less than normal, in which case *hypermetropia,* or *farsightedness,* results. The lenses of spectacles correct these defects by furnishing a sufficient amount of curvature to compensate for the abnormal curvature of the lens and cornea of the eye.

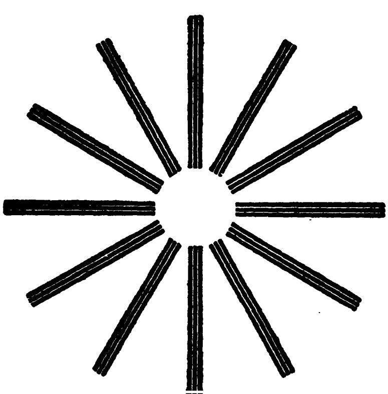


FIGURE 62.—CHART FOR TESTING ASTIGMATISM.

Another defect is *astigmatism.* In the normal eye, the refraction surfaces are spherical —that is, the curvature is the same in every meridian. In the astigmatic eye, this curvature is greater in some meridians than in others. Hence, vertical lines might be in focus, while horizontal lines would be out of focus. For the normal eye, all the lines of Figure 62 would appear equally distinct and

black; for the astigmatic eye, some would be black and others would be indistinct and lighter gray.

Visual defects with age

Usually, as one approaches the age of forty, he finds that, even though he can see objects distinctly at a distance of twenty feet, he is unable to read ordinary-sized print at the distance of about sixteen inches. This is so because the lens has lost its elasticity, and consequently the curvature is not increased for near distance. For this reason, it is necessary for the person of this age to wear glasses for reading. If the individual already wears glasses, he usually must now wear two sets of lenses: one of them a small segment set into the larger lens to correct his near vision, while the larger lens corrects the defects of his distant vision.

Eye movements in reading

If we observe the eyes of a person while he is reading, we can note that they move from one side of the page to the other, not smoothly, but by a series of jerks and brief pauses. It has been established that, during the jerks, the eyes are moving so rapidly that the printed page must be too indistinctly seen to make discrimination of the words possible. What we can read, therefore, is limited to the duration of the fixation pauses. It is as though short sections of the line were exposed in succession before our eyes. The discovery of these eye movements and fixation pauses has led to several problems of investigation:

1. How many fixations occur in reading a line of a given length?

2. Is there any relation between the number of fixations or their duration and the speed of reading?

3. Are the fixations sufficiently close together so that all of the line is eventually seen? That is, does the span of clear vision to the right of one fixation reach the span to the left for the next fixation, or is there a gap between in which words or letters are not actually seen but are filled in by our knowledge of the subject?

Several devices for recording and measuring eye movements have been used. The most successful consists in photographing the eye—that is, projecting upon a white spot attached to the eye a beam of light that is reflected to a moving, sensitive film and traces a line corresponding to the fixations on the printed material being read. In one such study,[1] the eye movements were recorded while the subjects read a selection

TABLE X

EYE MOVEMENTS IN READING

(The table shows the average number of fixations or pauses per line for each subject, the average word span per fixation, and the average duration, in fiftieths of a second, of each fixation. Adapted from the data of Miles and Bell.)

Subject	*Average Number of Fixations Per Line*	*Average Deviation*	*Average Word Span Per Fixation*	*Average Duration of Fixations in 1/50 of a Second*	*Average Deviation*
1	6.3	1.2	1.1	12.1	4.0
2	5.7	1.7	1.3	15.8	4.5
3	6.2	0.9	...	10.8	2.2
4	4.7	0.6	1.3	14.3	3.4
8	5.2	0.5	1.5	12.9	1.8
9	6.3	1.1	1.5	13.7	3.0
10	5.3	0.8	1.4	11.9	3.2
11	5.4	0.9	...	14.5	4.4
12	6.8	1.0	1.0	13.5	2.9
13	6.1	0.9	1.1	15.8	5.5
15	5.7	0.4	...	12.5	2.4
16	6.5	0.8	1.0	14.0	3.1

set up in lines sixty-seven millimeters long. Table X shows the results of this experiment. There was also found a marked correspondence between the speed of reading and the duration of the fixation pauses. In general, the shorter the pauses, the faster was the reading. On the basis of these and similar results, it is concluded that we may group readers into four types: (1) those who make a large number of fixations of long

[1] Miles, W. R., and Bell, H. M., "Eye-movement Records in the Investigation of Study Habits," in *Journal of Experimental Psychology* (1929), Vol. XII, pp. 450–458.

duration—these are certain to be slow readers; (2) those who make a large number of fixations of short duration—these are generally slow; (3) those who make fewer fixations but of long duration—these are generally fast readers; and (4) those who make few fixations of short duration—these are the most rapid readers.

Investigations of the span of vision in reading or of the distance on either side of the fixation point within which the letters can be distinctly seen indicate that we are able to see clearly all of the material read. In fact, the successive spans overlap considerably. More rapid reading is generally acquired by practice in reducing the number of fixations per line. This rapid reading is usually followed by a reduction in the duration of each fixation. Such reading, however, should not be confused with "skimming" a page. FOR EFFECTIVE READING AT HIGHER SPEED, GREATER ATTENTION OR ALERTNESS IS NECESSARY, AS WELL AS MORE RAPID EYE MOVEMENTS.

12

Perceiving (Continued)

Auditory Discrimination

Like vision, audition is of outstanding importance in our social life. Before the invention of written symbols for use as language, vocal transmission and auditory reception were the major constituents of social intercommunication. Manual and facial gestures were used to a limited extent, but the range of possible signals that could be devised for use through these processes is extremely small in comparison to the number of possible combinations of vocal sounds that can be discriminated orally in the form of articulate speech. All important communication between different groups of people was by the mouth-to-ear method.

Written language has advanced civilization primarily on the basis of permanent and accurate recording of events, and by providing an inexpensive and efficient method for one or more leaders to extend their social influences to all strata of society —even to all parts of the world—and both to contemporaries and to future generations.

Spoken language, however, will never be supplanted by written. Talking to a person, either directly or over a telephone, is much more personal and effective than communicating through writing. The radio has become an important instrument for both practical and esthetic aspects of our activities derived through auditory discrimination.

An important advantage that our capacity for auditory discrimination yields is that we do not need to orient ourselves to the sound source in order to make the discrimination. Many events that occur in the *visual* world about us escape our attention because we are not "looking" in that direction; but whenever anything happens in the *auditory* world that is of sufficient intensity, we may react to it regardless of our spatial orientation. Sometimes, however, owing to our particular set or preoccupation, we do not discriminate auditory events that are above the ordinary threshold of hearing.

There are numerous minor auditory discriminations that we make day by day and that form an essential part of our social behavior. If we were not in possession of auditory organs capable of exceptionally minute discrimination, we could not make use of these cues, and consequently our social behavior would be not only less complicated but also less efficient. For instance, another person may speak the same words in a great variety of ways, and our whole interpretation of the attitude of the other individual rests on the basis of slight auditory discriminations of differences in these sounds. That such factors are effective on a strictly oral basis, apart from facial expression and bodily posture, is indicated by the fact that, even over the telephone, we make such discriminations.

We may be in the presence of a number of individuals talking; there may be noises from vehicles passing on the street or sounds from instruments and machinery. Still, we can discriminate cues of significance to our particular interests that are much weaker in intensity than most of the others occurring at the time. A skilled choral director may be listening to one hundred voices singing six-part music and be able to detect one person singing off pitch. Thus, not only can we discriminate a large number of sounds occurring simultaneously, but we can also analyze the complex into discrete and minor changes to which we may react directly and separately.

The auditory stimulus

In order to make clear how we make auditory discriminations, it will be helpful to describe in some detail the auditory

stimulus that is caused by the vibration of some elastic body which, under ordinary conditions, produces in the air a series of *alternate condensations and rarefactions* that are transmitted by the air to the ear, although any elastic medium may conduct these sound waves. Suppose that a steel rod is clamped to the table at one end. If the free end is pulled to one side and released, it will swing forward and backward in pendular motion. As it swings forward, it condenses the air particles immediately in front of it; and these, in turn, condense the next particles. Thus a wave of condensation moves

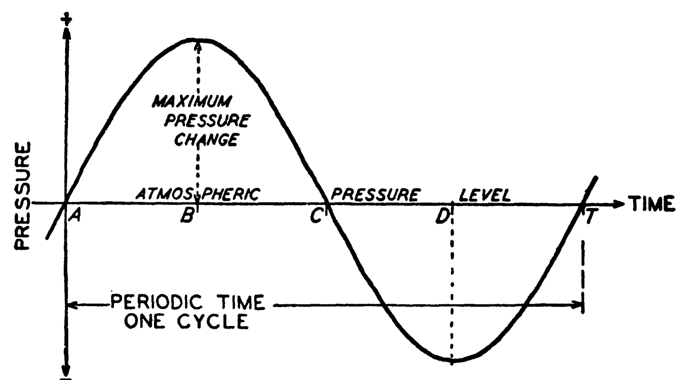


FIGURE 63.—SINE-CURVE REPRESENTATION OF PRESSURE VARIATION. (*Valentine, "Readings in Experimental Psychology."*)

forward from the rod. But the rod immediately begins the backward swing, leaving a rarefied space that draws back the displaced air particles; and these, in turn, produce a wave of rarefaction that proceeds forward behind the wave of condensation. As the rod continues to vibrate, condensation and rarefaction succeed each other.

If the rod vibrates slowly, the distance from the center of one condensation to another would be greater than it would be if the vibrations were more frequent. Sound waves travel approximately 1,100 feet per second. Therefore, if there are 100 vibrations per second, the distance from the beginning of one condensation to the beginning of the next condensation—one complete oscillation—would be 11 feet. If the vibration frequency is greater, the wave length will be less. It is usual

to speak of a *cycle* as a complete oscillation from rest to the extreme excursion in one direction, back to the opposite position, and then to rest again. The distance the alteration in the air particles has gone in the same period is known as the *wave length.*

For convenience, it is customary to represent a simple sound wave as a periodic curve, such as the *sine curve* in Figure 63. During the time *AB*, the pressure is increasing, attaining a maximum value at *B;* from *B* to *C,* the pressure diminishes, attaining at *C* the same pressure that existed at *A*. The difference between atmospheric pressure (*A* or *C*) and the pressure attained at *B* represents the *amplitude* of the sound wave and determines the intensity, or energy, of the sound for any specific frequency. From *C* to *D*, the pressure diminishes below the atmospheric pressure level. The curve *AT* represents one cycle of the sound wave. The *frequency* is denoted as the number of cycles per second. For example, middle *C* on the musical scale has a frequency of 256 cycles. The frequency, or number of cycles per second, closely corresponds to what we call the *pitch* of a tone. Thus, a tone produced by 250 cycles is higher in pitch than one produced by 128 cycles.

Compound pressure variations

All the pressure variations caused by ordinary disturbances in nature are compound waves. Single sine waves can be

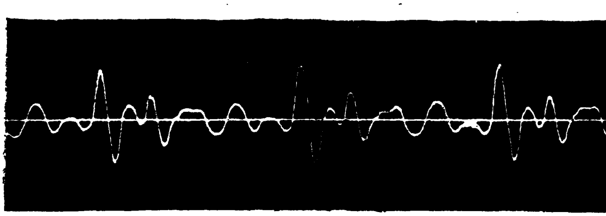


FIGURE 64.—A CURVE REPRESENTING THE COMPOUND SOUND WAVE GENERATED BY A BASS VOICE SINGING THE VOWEL *a* AS IN *Father* ON THE NOTE F (FREQUENCY LEVEL, 92 CYCLES). (*From Miller, "The Science of Musical Sounds," p. 205*).

produced, but only under rigorously controlled laboratory conditions. Compound waves that have a periodically recurring wave form, such as that shown in Figure 64, may be analyzed

physically and mathematically into a discrete number of simple sine waves occurring simultaneously. These components of the compound wave differ from one another in amplitude and frequency, and correspond to the *partials* of a complex tone, the partial with the lowest frequency being the *fundamental.*

Ordinarily, we do not directly discriminate the partials; but we can easily distinguish between the same note of the musical scale when it is produced by two different instruments—say, the violin and the trumpet. While the fundamental is the same in both cases, the frequencies and amplitudes of the components are not the same.

Thresholds for loudness

Until recently, it was not possible to control the frequency and intensity of vibrations to a sufficient extent to make quantitative measurements with the exactness that was possible in the case of vision. With the development of electrical circuits, which involve the same principle as that applying to the common radio circuits, measurements of this sort have been made possible.

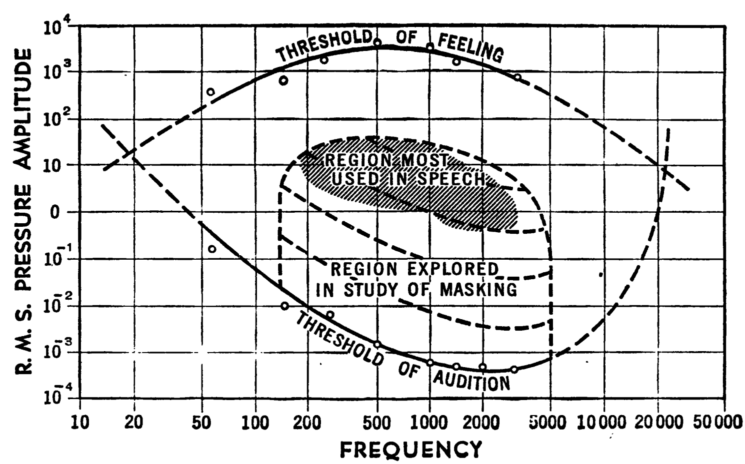


FIGURE 65.—UPPER AND LOWER THRESHOLDS FOR LOUDNESS AS A FUNCTION OF FREQUENCY LEVEL.

Figure 65 represents the stimulus intensity necessary to

produce a just audible sound (of initial threshold) at the various frequencies. On the abscissae are plotted the frequencies, and on the ordinates the energy values or stimulus intensities.[1] The lower curve represents the minimum intensity of stimulus to which a subject will react. It will be seen that the greatest sensitivity is from approximately 1,000 cycles to 5,000 cycles, and decreases rapidly for lower and higher frequencies. It was also found that, if the intensity were greatly increased, there was reached a limit at which auditory response was masked by other sensory processes, which limit represents the maximum intensity. This is shown by the upper curve. These curves represent the average results for several subjects. Where the two curves meet, we have the limits of audible frequencies.

Over the frequency band of 512 to 4,096 cycles, differential pitch sensitivity does not vary significantly; but from 512 to 64 cycles, this sensitivity diminishes at a rapid rate, as it likewise does from 4,096 cycles to the upper threshold for pitch. Although these minimal changes in the pitch-discrimination function are seldom recognized in ordinary biosocial behavior, it is interesting to realize that, over the frequency band of 256 to 4,096 cycles—the levels most used in music—the differential pitch sensitivity of the ear is at a maximum.

Analysis of speech sounds

That speech is dependent upon the production of several vibration frequencies, which are relatively pure for the vowels and complex for the consonants, has been demonstrated by several investigators. An instrument, the *phonodeik,* has been perfected, by which sound waves may be represented by an oscillating point of light, and this oscillation is photographed upon a film moving transversely to the oscillations of the point

[1] In the preceding sine-curve representation of a sound wave (Figure 63), the area between the axis and the curve is considered the measure of the amplitude of energy of the stimulus. This may be mathematically determined as the *root mean square* of the area under the curve. The unit of measurement of force is the *dyne*. It is a force which, acting upon one gram for one second, will impart a velocity of one centimeter per second.

of light. The resulting curve is that usually employed to represent a sound wave. By means of the *harmonic analyzer,* this curve can then be analyzed into the constituent sine waves. Figure 66 illustrates the distribution of energy among the partials when the same vowel is intoned at various pitches.

It has been shown that, when a vowel is intoned, there is a wide range of frequencies that make up the quality of the voice; but the greater part of the energy is in those partials that fall within certain well-defined limits, no matter at what

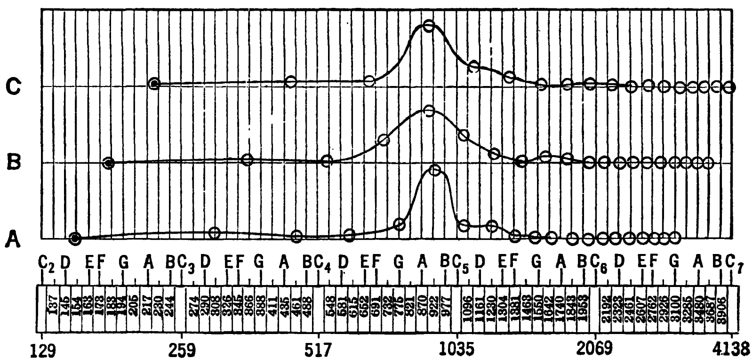


FIGURE 66.—DISTRIBUTION OF ENERGY AMONG SEVERAL PARTIALS OF THE VOWEL *a* (*Father*) INTONED AT VARIOUS PITCHES. *A,* intoned at the pitch 155 *d. v.; B,* at 182 *d. v.; C,* at 227 *d. v.* (*Modified from Miller, "Science of Musical Sounds," p. 221, The Macmillan Company.*)

pitch of the voice the vowel is uttered. Some vowels are characterized by two regions of dominance of partials. Thus, the vowel *e* (as in *meet*) is represented by the partials approximating 300 cycles and 3,100 cycles, while *u* (as in *moo*) is limited to the partials in the region of 300 cycles alone. The accompanying table gives the vowels and the corresponding frequencies (Table XI).

These figures are not absolute because the vowels are not spoken accurately. We approximate the correct sound and leave our listener to interpret it. It will be observed that there is a variety of sounds indicated by *a* that cannot be represented adequately in print. However, the chief point to be remembered is that each vowel possesses its own characteristic frequencies, which do not vary with the pitch of the voice.

TABLE XI

REGIONS OF MAXIMUM FREQUENCY

Vowel	*First Region*	*Second Region*
u (*moo*)	326	....
o (*mow*)	462	....
a (*maw*)	732	....
a (*ma*)	910	....
a (*mà*)	1,050	....
a (*ma*)	950	1,240
a (*mat*)	800	1,840
e (*met*)	691	1,953
a (*mate*)	488	2,461
e (*meet*)	308	3,100

When vowels are whispered, the voice sounds are practically absent and the larynx is relaxed. The result may be considered very nearly a pure vowel sound. Consonants may be considered in the class with noise. They possess some pitch, but it is not so important; they may be better expressed as hissing, explosive, and rolling sounds.

The sounds of speech that must be discriminated are rather limited, as compared with the absolute limits of pitch and loudness discrimination of which the normal human being is capable. This fact is illustrated by the shaded portions of Figure 65. When we remember that the upper and lower curves bound the area of auditory discrimination, as regards both loudness and pitch, we find that the requirements for the understanding of spoken language are not very great.

Noise

In the preceding sections, we have considered only those auditory discriminations that are classified under the heading of *tone*. Tones are produced by simple pendular vibrations or by combinations of vibrations that are in the simple ratios of 1:2:3 . . . , such as are obtained from a vibrating string. If this complex of vibrations is not in such a harmonic ratio, we speak of the result as a *noise*. Thus, the scraping of the bow of the violin produces a noise that can be discriminated in addition to the tone, because these vibrations have no simple

ratio to each other. When a resined string attached to a tin can is drawn through the fingers, the resulting noise is due to the complex vibrations that have no simple relation.

Another factor in noise is the presence of beats that occur through the interference of the component vibrations. It is also found that, if the stimulus of a pure tone is cut short, so that less than two double vibrations are allowed, the reaction is that of a sudden noise. This result may be due to the fact that the brief disturbance of the tympanic membrane has the effect of setting up a complex of vibrations, as would be the case with a complex stimulus of longer duration. This condition would be analogous to the action of a telephone receiver, the disc of which may vibrate to a continuous oscillating current in the form of a sine wave; but if the current is suddenly shut off or is intermittent, it breaks up into complex vibrations that have no relation to the frequency of the electric current.

As a noise is usually the result of several vibration frequencies, one of which may dominate, it is to be expected that noises may possess some of the characteristics of tones. Some noises are high in pitch and others are low, corresponding to their dominant frequency. Noises may be discriminated in various ways. The boom of a big gun, the crack of a pistol, the whine of a bullet, the squeak of an ungreased bearing, and the roar of a waterfall express some of these characteristics. Evidently, the difference between tone and noise is relative, depending upon the complexity and the ratios of the component frequencies. Because of this greater complexity in the case of noise, our differential sensitivity in response to it is not so great as it is for tones, when the same standards of measurement are used.

Auditory Space Discrimination

Distance discrimination

The auditory discrimination of distance is not nearly so accurate as the visual discrimination of distance. We may hear a noise and judge it to be far away or very near, when

the opposite is really true. Footsteps in the street and the sound of a whistle in the distance will be very inaccurately judged as to their distance. This is so partly because it has not been necessary for us to depend upon auditory cues, since we usually use our vision for the more accurate discriminations. Doubtless, if we were unable to use vision, we would develop greater accuracy in our auditory discriminations. The fact that we do make auditory discriminations is dependent upon several factors.

In the first place, the intensity of a sound decreases as the square of the distance of the source from the listener. If, therefore, we know the character of the sound, we may judge how far away the source of the sound is by its relative intensity. Also, as most sounds are complex—that is, contain several partials—we may be guided in our determination of their distance by the character of the tone that we hear. Some of the partials will be weaker than the others, as a result of the distance traversed by the sound.

Discrimination of direction

We can also localize or determine the direction of the sound source with a fair degree of accuracy, provided the vibrations are not reflected from other objects in the environment. We frequently hear echoes. Thus, if we are standing on one side of a building, the sound of an automobile horn on the opposite side of the building may seem to come from across the street, because the vibrations travel around the building and across the street and are reflected back from the buildings on the opposite side. Our ability to localize the direction of the sound source depends upon one of three factors, and possibly on all of them:

1. *Intensity difference.* It will be recognized that, if the sound source is to one side of the individual, the sound should be more intense to the ear nearer this source than it is to the ear on the opposite side. Experiments have indicated that, if the vibrations are led to each ear separately and the intensity is shifted, the tone will be recognized as at the ear receiving the more intense stimulation. If the tone is complex, we

would also have a difference in the character of the tone as it is heard at the two ears, owing to the shifting intensity relations between the various partials.

2. *Temporal difference.* It will also be recognized that the tone should reach one ear sooner than it does the other if the source is to one side. The exact temporal difference can be calculated when we remember that vibrations travel approximately 1,100 feet per second in the air. Subtracting the difference in distance from the source of sound between the near ear and the far ear, we can determine how much sooner the sound reaches the one than it does the other. This advantage would apply to instantaneous sounds, but would not apply so readily to continuous tones.

3. *Binaural-phase ratio.* The most difficult factor to understand and yet, within certain ranges of frequency, probably the most important factor is what we call the *binaural-phase ratio.* Let us consider a pure tone, which is one produced by a single harmonic vibration of the type described in Figure 63. We can see that, if the vibration must travel farther to reach the more distant ear, the wave at that ear would be different from the one at the near ear. In other words, we may assume that the pressure against the near ear is at its maximum, represented by 90 degrees. As the wave reaches the opposite ear a little later, the pressure would not quite have reached the maximum. In other words, it would be 90 degrees minus a small quantity. So, throughout the period of stimulation, the one eardrum would be affected slightly earlier than the other. Any particular point in the curve represented in Figure 63 is known as a *phase.*

An experiment to demonstrate the effect of this phase difference may be performed in the laboratory with two tuning forks of nearly equal frequencies. One fork may have a vibration frequency of 256 cycles, and the other one of 257 cycles. Naturally, if they are both vibrating at the same time, every second one will go through one more cycle than the other does. Let us assume that both start a condensation at the same instant. The one of higher frequency will gain on the one of lower frequency. It will have finished a condensation and

have started a rarefaction before the other reaches the peak of condensation. In time, it will have gained sufficiently to be in the condensation phase (*B*, Figure 63) when the slower fork is in the rarefaction phase (*D*). As this continues, both will again be in the same phase.

We can see that, if the amplitudes of the two waves are equal, when they are in opposite phase, the condensation of the one wave should be neutralized by the rarefaction of the other, and no tone should be audible; and that when they are in the same phase, one should re-enforce the other and the tone should be louder. This is actually the case. In the example given, we hear a tone of rising and falling intensity once every second.

Now, if the two frequencies are led one to each ear, we hear, not a tone of varying intensity, but a tone that at first appears at one ear and then shifts to the other. It can be shown that this shift is determined by the phase relation between the two tones. When one wave is leading, the tone is localized on that side.

Interpretations

Numerous attempts have been made to explain these phenomena. It sometimes has been believed that the phase difference at the two ears resulted in an intensity difference, it being assumed that the vibrations were transmitted by bone conduction through the head from ear to ear. Recent investigations, in the case of individuals totally deaf in one ear, have proved that a vibration presented to the deaf ear cannot be heard, even though this sound is sufficiently intense to be discriminated in the localization experiments with normal subjects. It seems probable that the temporal difference in the pressure at the two ears is directly discriminated as representative of direction.

IT SHOULD BE REMEMBERED THAT OUR ABILITY TO LOCALIZE AT ALL IS DEPENDENT UPON THE FACT THAT WE HAVE MOVED ABOUT AND HAVE SEEN THE OBJECTS AT THE SAME TIME THAT WE WERE STIMULATED THROUGH THE EAR. Just as in our visual discriminations we are dependent upon other senses in learning

to discriminate, so in the case of audition we have learned to localize sounds because we have dealt in many other ways with the objects producing sounds.

Touch, Movement, and Equilibrium

Because the eye and the ear are such highly developed, special receptors, we are frequently led to believe that our visual and auditory discriminations are more important than our discriminations resulting from the more primitive receptors. It would be difficult to imagine, however, how we could get along in everyday life if we were entirely devoid of the ability to discriminate by means of the receptors in the skin. We would not be able to localize what part of the body was being stimulated when we came in contact with objects; we would not be able to gain important knowledge through manipulating objects that we see—an ability we have already noted as an important part of our visual perceiving.

In a like manner, we can see how important it is that we can perceive the movement of the members of our own body. We have gained our visual perception of space very largely through the fact that we have been able to move—to reach out for objects or to walk to them. Our ability to stand upright, as well as to make many movements that require a change of position, is dependent upon our ability to discriminate position. We maintain our balance or our equilibrium. THESE ARE ALL IMPORTANT DISCRIMINATIONS WITHOUT WHICH OUR VISUAL AND AUDITORY RECEPTORS WOULD BE OF LITTLE VALUE.

Cutaneous Space Discriminations

Tactual localization

If the person is stimulated on his hands, face, or neck, he is able to tell in what general locality the stimulus has been applied, but he is unable to describe this touch in one area as different from that in another. It is the same touch or the same pressure, except that it is in a different locality. This is very similar to what we found in visual space. We just seem

to "see" the object out there visually, and we simply "feel" the stimulations on the skin as being on the cheek, hand, and so on.

Experiments have shown that we are able to localize a touch on the skin more accurately in some areas than in others. If a pointed brass rod is brought into contact with the fingers of his left hand, the subject can, with eyes closed, indicate the specific area by touching it with a pencil point, with an error of only one or two millimeters. If the area stimulated is on the back of the hand, he will still be fairly accurate but is likely to make an error of five or six millimeters. On the forearm, his error will be as much as from ten to fifteen millimeters. On other areas of the body, we find similar variations in accuracy of localization.

The individual, in other words, exhibits some degree of accuracy in localizing contact on the skin, and this accuracy is greatest on those parts that are most mobile. Thus, we find that, as we progress from the upper arm to the lower arm, the hand, and the tips of the fingers, the subject becomes more and more accurate.

Two-point threshold

If two points are stimulated simultaneously, they may be recognized, not as two points, but as one. As the points are more widely separated, a distance may be determined at which they will be just noticed as two. To determine this *two-point threshold* on a given area, an instrument similar to the one illustrated in Figure 67 is generally used. If we start with the two points near enough together so that they are judged as one, we continue increasing the distance between them until they are judged as two, then take the reading, and move the points far enough apart so that they are easily discriminated as two points when they touch the skin. The distance is then repeatedly decreased until the subject reports one point.

After this experiment has been repeated several times, the mean of all the readings is determined and is considered to represent the two-point threshold. This threshold will be greater on the back of the neck in the longitudinal direction

than it is in the transverse, but it is much greater in either direction there than on the forearm. Again, it is still less on the hand and the tip of the finger.

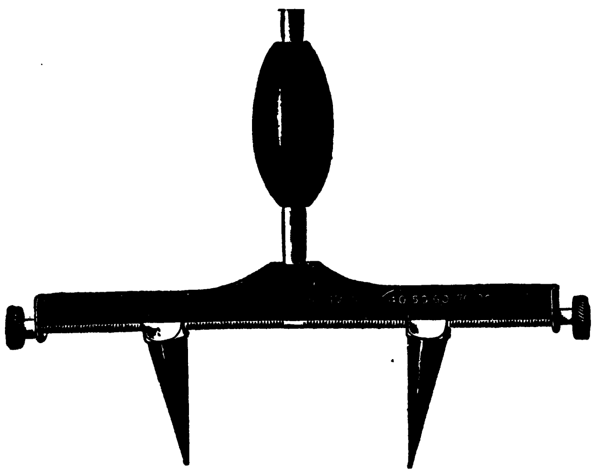


FIGURE 67.—DOUBLE ESTHESIOMETER FOR THE DETERMINATION OF THE TWO-POINT THRESHOLD. (*C. H. Stoelting Co.*)

Explanation of cutaneous discrimination

It may be shown,[2] however, how this localization has been learned through the reactions the subject makes to stimulation. To take an example, let us suppose a starfish is stimulated on one arm. All the arms will respond, but only the response of the one directly stimulated will directly affect the stimulus. Its movement will either increase or decrease the stimulus. In time, the other arms will cease to react when this arm is stimulated. The stimulus, we say therefore is localized in this arm. With further stimulation of one area on this arm, the response will become more limited to this area. The starfish will respond differently when this area is stimulated than when some other area on the same arm is stimulated.

The same principle applies to human learning of localization. THE ACCURACY OF LOCALIZING IS DIRECTLY RELATED TO THE

[2] Peterson, Joseph, "Local Signs as Orientation Tendencies," in *Psychological Review* (1926), Vol. XXXIII, pp. 218–236.

DEGREE OF MOBILITY OF THE PART STIMULATED. The error of localization and the two-point threshold are greatest on the trunk, less on the arm, and least of all on the tips of the fingers. Furthermore, the accuracy is greater in the transverse than in the longitudinal direction on the forearm, and we can more easily rotate the arm than we can move it forward and backward.

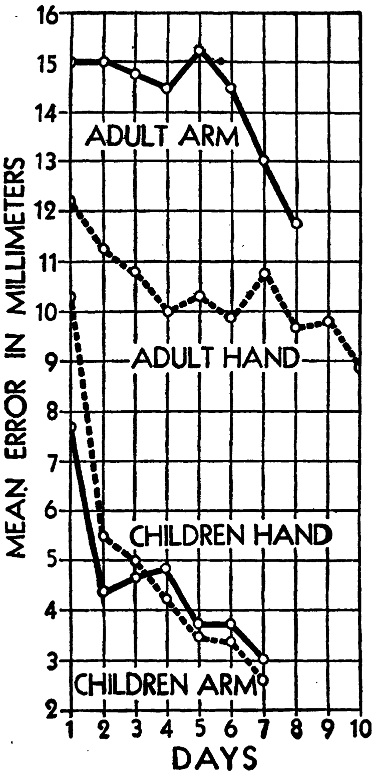


FIGURE 68.—MEAN DAILY ERRORS OF LOCALIZATION ON THE HAND AND FOREARM BY ADULTS AND CHILDREN. (*After Renshaw.*)

Localization in children and the blind

The significance of the argument that localization is a function of learning is more forcefully exemplified by a comparison of the results with children and with adults in tactual localization. If such discriminations are due to training, we might naïvely expect that error in localizing would be greater with children than with adults. Experiments, however, have demonstrated [3] the reverse to be true, as is shown in Figure 68. It will be seen that adults are considerably more inaccurate than children and that they are less accurate in localizing on the arm than on the hand, while the children exhibit very little difference in these two areas.

[3] Renshaw, S., "The Errors of Cutaneous Localization and the Effect of Practice on the Localizing Movement in Children and Adults," in *Journal of Genetic Psychology* (1930), Vol. XXXVIII, pp. 223–238. Also: Renshaw, S., Wherry, R. J., and Newlin, J. C., "Cutaneous Localization in Congenitally Blind versus Seeing Children and Adults," in *ibid.*, Vol. XXXVIII, pp. 239–248.

The explanation for this apparent paradox is to be found in the fact that the children are learning to localize *tactually*, while the adults have passed this stage and have learned to substitute *visual* cues. The investigators tested this hypothesis in this way: In one group of tests, the subjects, with eyes closed, attempted to touch the spot stimulated. In an alternate test, they were allowed to open their eyes immediately after the stimulation, and then to attempt to locate it. The average error for the children was 7.9 millimeters under the first condition and 9.41 millimeters under the second. In other words, the children were more inaccurate in localizing when they could see the area just stimulated. The corresponding results for the adults were 10.37 millimeters with eyes closed and 6.16 millimeters with eyes open. The adults' visual cues were a decided advantage.

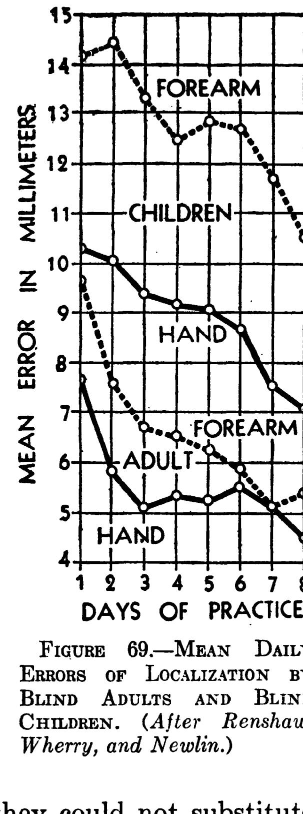


FIGURE 69.—MEAN DAILY ERRORS OF LOCALIZATION BY BLIND ADULTS AND BLIND CHILDREN. (*After Renshaw, Wherry, and Newlin.*)

This fact of substitution of visual cues is further demonstrated by the comparison of the errors of blind adults and children. Figure 69 shows that the errors of blind adults are less than those of blind children. The adults continued to improve in purely tactual localization because they could not substitute vision.

Discriminations of Movement

Discriminations of movement cannot be attributed to a single class of receptors but are really dependent upon receptors located in several positions of the member that is moved. When we move the arm, for example, the skin about the joint

is bent, stimulating cutaneous receptors. There are also receptors in the muscle and tendon that are stimulated by the pressure produced by the strain upon the muscle or tendon. There are also some receptors apparently on the surface of the joint that may be stimulated as the two surfaces rub together in movement.

If, for example, the skin is anesthetized and pressure applied over a muscle or tendon, a response is elicited that is termed the *deep-pressure sense.* It is possible to perform a laboratory experiment indicating the relative importance of these receptors in the skin, joint, tendon, and muscle. The arm of the subject is placed upon a tilting board, with the elbow at the stationary end of the board. If the movable end of the board is raised very gently, the arm is moved passively. The subject is to report when he realizes that the arm is being moved. In this way, it can be determined how far the arm can be moved passively before the subject discriminates the movement. If, now, the skin about the elbows is anesthetized by spraying with ether, which chills the receptors, and the arm is again moved, it will be found that greater movement is necessary before the subject reports any movement at all. In the third test, a weak induction current is sent through the elbow joint, anesthetizing the receptors in the joint surface. The same procedure may be used with both tendon and muscle. The results indicate that the receptors in the muscle and tendon are most important in discrimination of movement of this kind but that the receptors in the skin and joint also contribute.

The importance of the *kinesthetic sense,* or deep sensibility, cannot be too greatly stressed. The muscles are always in a state of partial contraction, and hence these end organs are constantly stimulated. Bodily posture and the tonic condition of the muscles, as well as the movements made in response to efferent impulses, are due in large part to the impulses sent in by these systems. In fact, it would be impossible to conceive of the behavior of a person in whom these impulses did not exist. Although its organs are not so highly developed as the sense organs for vision and audition, the kinesthetic sense is of fundamental importance for behavior.

Equilibrium

In addition, from the end organs in the muscles and tendons, the afferent impulses of which control movements and the tonicity of the skeletal muscles, and thus are responsible in large measure for our ability to stand or walk or maintain any normal position, there are also special mechanisms in the inner ear that are closely associated with the same functions (Figure

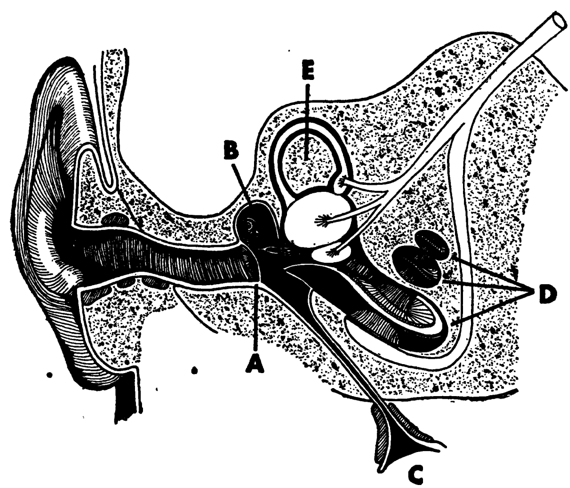


FIGURE 70.—CROSS-SECTION OF THE SKULL SHOWING THE RELATIONSHIP OF THE MIDDLE EAR, COCHLEA, AND SEMICIRCULAR CANALS. *A,* tympanic membrane; *B,* middle ear; *C,* Eustachian tube connecting middle ear and pharynx; *D,* cochlea; *E,* semicircular canals. (*Hough and Sedgwick, "Human Mechanism," Ginn and Company.*)

70). Because of their proximity to the cochlea, it was formerly assumed that they too were end organs of hearing, but this assumption has been generally abandoned. That these mechanisms are important in the maintenance of equilibrium and help to maintain our control of movement is easily demonstrated. Every small boy has amused himself by turning around several times and then standing still to see the room go round. We shall see, however, that, although these organs do function in maintaining balance, they are not the only means of such control.

Balance mechanisms

Close to the cochlea and continuous with it are three *semicircular canals* and two sacs, the *sacculus* and *utriculus*. They form a continuous labyrinth in the cavities of the skull. The three semicircular canals are situated at right angles to each other, two being vertical and one horizontal. The two vertical canals each make an angle of forty-five degrees with the median plane of the head. By this arrangement, the anterior canal of one side and the posterior canal of the other side of the head fall in parallel planes.

There is an enlargement, the *ampulla,* of each canal near its junction with the utriculus. Within the ampulla are the *cristae,* or supporting cells, which contain long, cylindrical hair cells, the hair processes extending into the endolymph. The sacculus and utriculus contain hair cells and supporting cells forming the *macula.* Lying among the hairs in the macula are small crystals of calcium carbonate.

Experiments in rotation

If the subject is seated in a rotating chair, with eyes closed and instructed to report regularly the direction in which he is rotated, he will report correctly as the chair is accelerating; but as soon as the speed of rotation becomes uniform, he will report that the rotation is slowing down or has actually stopped. As the speed of rotation is decreased, he will report that he is being rotated in the opposite direction. Two facts are to be noted: (1) if the speed of rotation is perfectly constant, the subject does not appreciate that he is being rotated; and (2) it is only during periods of acceleration or deceleration that the subject reports movement. Evidently, to the extent that the semicircular canals function in this experiment, they are effective only at times when the speed is changed and a disturbance is caused in the hair cells. These cells apparently become quickly adapted to their changed position when the movement becomes constant.

Nystagmus

A typical optical reflex may also be demonstrated as a result of rotation. If the subject is rotated several times with his eyes closed, and then is suddenly stopped and opens his eyes, it will be observed that his eyes make slow movements in the direction of the previous rotation and quick jerks back to the original position. This is called *postrotational nystagmus.*[4]

The explanation of these phenomena is that the endolymph in the horizontal canals during the acceleration of rotation lags sufficiently to press against the hairs of the cristae; but when rotation is completely stopped, this fluid, by reason of its inertia, again presses against the hairs in the opposite direction. As a result of this stimulation, the eyes are stimulated to movement as they would be if the individual were turning. Consequently, the objects at which he looks seem to be moving in the opposite direction, and he makes quick readjustments or pursuit movements to keep up with the apparently moving objects. For this reason, when the small boy has been whirling in a swing, everything seems to be swimming about him. Really, the reverse stimulation of that to which he is accustomed is taking place. In other words, the stimulation of the semicircular canals has assumed dominance over the usual visual field.

Falling experiment

Similar experiments affecting the other canals may be performed. For example, if the subject leans forward until the vertical canals are in a horizontal position and then, after rapid rotation, sits up quickly without opening his eyes, he will fall in the direction in which he has been rotated, although he will report that he was falling in the opposite direction. The explanation of this phenomenon is the same as that of the nystagmus: the violent stimulation of the vertical semicircular canals produces the effect of falling in the one direction, and

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[4] Valentine, W. L., *Response to Rotation and Translation,* a moving-picture film prepared at Ohio State University.

the subject's attempt to sit upright throws him in the opposite direction.

These experiments indicate that the semicircular canals function through the movement of the head to stimulate muscular responses that maintain the co-ordinations involved in equilibrium. In addition, it is supposed that the otoliths in the sacculus and utriculus press upon the hairs when the head is in the upright position, and thus function in static equilibrium.

There is a quick adaptation to these stimuli if they are continued long enough. Acrobats and dancers do not become "dizzy" as a result of being rotated.

Other cues to equilibrium

That, in equilibrium, we use other cues—such as vision and the stimulation of receptors in the muscles and tendons—is quite evident. In experiments that have been performed upon pigeons, part or all of the semicircular canals were removed. At first, the pigeons walked in circles and had difficulty in standing or eating, but ultimately they could not be distinguished from normal pigeons. This return to normal behavior is attributed to the establishment of visual or kinesthetic cues as substitutes for the labyrinthine stimulation. One pigeon was observed to behave normally a few days after the operation as long as he remained in a small cage; but when placed on the floor, he showed all signs of the disturbance. When the cage was set over him, he promptly stood up and walked normally until the cage was again removed. This act indicated that the visual cues of the cage were necessary at this stage in his recovery.

In many cases, individuals suffer from an infection in the inner ear. The infection destroys not only the auditory mechanism but the semicircular canals. Although they are hopelessly and totally deaf, they suffer no great permanent inconvenience because of the loss of the semicircular canals. They evidently learn to depend upon the muscular cues. During the First World War, it was assumed that aviators could not fly if the semicircular canals were defective. This was because

it was believed that, in the air, the individual lacked the normal support of the other senses that he has on the ground, and that he must depend only on the so-called "sense of equilibrium." This belief is not entirely accurate. A pilot sits upon a seat, resting against the back, and he is usually protected by a wide belt about his waist. The pull of gravity will give him many cues that we call *tactual* and *deep-pressure,* which will indicate to him whether his plane is upright, even though he cannot see the ground. There were numerous reports that pilots who flew through a dense cloud would come out to find their plane bottom side up. If these stories were true, one can only infer that the pilot was so greatly disorganized that he did not appreciate the cues presented because of the fact that he was sagging against the belt, blood was rushing to his head, and the pressure on the seat was eliminated.

Summary

In reviewing our description of sensory discriminations, we may conclude that, although we possess two highly developed receptors in the eye and the ear, the most important fact concerning discriminations is that, in all of them, the functions of the various receptors are very closely interrelated. Our visual discrimination of space is dependent upon what we have learned through tactual and kinesthetic receptors. The same is true with regard to our auditory discriminations. On the other hand, because we possess these highly developed tactual and kinesthetic receptors, we are also very largely dependent upon them in learning to discriminate. Even though the semicircular canals are important in our discrimination of position and movement, these stimulations are intimately bound up with visual, tactual, pressure, and kinesthetic processes. It is only in unusual laboratory situations that any one receptor mechanism plays a dominant role.

13

Learning and Remembering

The Problem of Learning

If this book were a novel instead of a textbook, we should just about be at the climax of the story. Although you may have found the "plot" of this story a bit thin, you should be ready by now to tackle one of the most important topics in the whole field of psychology. This topic is the role of learning in our everyday lives. The college student is probably more acutely aware of the importance of learning than are most people who go about their daily affairs without the frequent checks upon their attainment that are part of the student's life. The chief task of the student consists in learning a vast amount of new material each week. He may be enrolled in four courses: English literature, German, mathematics, and zoology. These require the learning of the content of certain literary productions, vocabulary, grammar, symbols and formulas, facts about living organisms, and a host of other facts and principles. The college student knows better than anyone else that the popular belief that college is simply a place where one learns to "think" is an unfortunate overemphasis upon only one phase of his work. Thinking cannot be done in a factual vacuum. He knows that, before he can arrive at legitimate conclusions or before his opinions can carry any weight, he must know literally hundreds of facts and principles, or at least know where to find them.

Not only does the task of learning seem enormous to the

student, but he is also concerned with the fact that he forgets so readily what he thought he had learned. "What is the use of learning all this stuff if I have difficulty in remembering enough even to pass my final examination? In two weeks, I will have forgotten it all anyhow." This is an unfortunate confession. It represents the truth in more instances than either student or faculty is willing to admit. On the other hand, it is not always true in those instances where it is made. To deny all aid from the outside in the attainment of one's goal, to refuse to give any credit to parents, school, college, or friends is a form of self-flattery. We do not expect flattery to involve much truth. It is one of the marks of the "self-made" person. To make such a claim, the individual must completely deny any conceivable benefits derived from education or formal learning. Of course, the crucial test of this belief would occur if, somehow or other, we could suddenly deprive such people of the aid they had received from these sources and observe what happened to them. Since such a test is impossible, however, we shall probably always have individuals who in one breath will denounce the benefits derived from a formal education and in the next protest any suggestion that they leave college and seek their own fortune.

Most students are agreed, however, that there is a great deal to be derived from their college experience, from living up to the requirements made of them, and from executing their assignments. Some are willing to go even further in their quest of information and skills, and will do unassigned work toward this goal. These students make a very reasonable request of psychology. "What," they ask, "can I get from a study of psychology that will make me more efficient in my job as a learner?" It will be our task in the following chapters to examine some of the experimental evidence regarding the economies of learning and the most efficacious methods of ensuring that the material learned will fulfill its usefulness. It is not essential that everything we learn shall be remembered for all time. Forgetting is as important as remembering, provided we understand it and can govern our actions accordingly.

BEFORE READING FURTHER, YOU MUST READ AGAIN THE MATERIAL IN CHAPTER IV. In that chapter, we defined *learning* and noted some of the conditions under which it occurs. There is no point in repeating that material here, but an understanding of it is essential to what is to follow.

Measures of learning

In Chapter IV, it was not necessary to go into the detail that we must now consider in order to understand fully the nature of the learning process and the conditions under which it occurs. IN THE FIRST PLACE, IN ORDER FOR US TO SAY THAT A PERSON HAS LEARNED SOMETHING, WE MUST HAVE OBSERVED SOMETHING ABOUT HIS BEHAVIOR. The rigor with which we make such observations is entirely a function of the demands of the moment. It is true that some will be satisfied with nothing more than a statement that some time has been spent in learning, that some practice has been engaged in. "Mary has taken piano lessons for two years." Can we say that Mary has learned to play the piano? A kind relative or an indulgent friend may be willing to concede that Mary has learned to play. A music teacher, however, will insist that Mary play a few bars on the piano. THE TEACHER WILL DECIDE ENTIRELY IN TERMS OF MARY'S PERFORMANCE, HER BEHAVIOR AT THE PIANO, WHETHER LEARNING HAS OCCURRED.

This point relating to some check on the behavior before judgment about learning may be passed is an important thing for the student to remember. Too many times your judgment regarding the amount you have learned is based entirely upon the amount of time you have spent studying. You have probably already been made aware of the fact that your professors are only very slightly impressed by your reports of the amount of time you have spent in practice. They base their judgments regarding the efficiency or extent of your learning exclusively upon what you do. There is no reason why you cannot be just as rigid in your demands upon yourself. You may use exactly the same yardstick and determine for yourself just how effective your study has been. The important thing is that you can do this before you are actually graded on your

performance and then still have time to correct errors or take whatever other steps you care to.

How may we determine that learning has taken place? In other words, what measures of learning are available to us? There are three that are used most frequently:

1. We might use number of errors as the measure of learning in card playing, automobile driving, learning to tell time by the clock.
2. Amount of time consumed could be used as a measure of learning in cooking, repairing machinery, and writing.
3. Number of correct responses might be used in learning to type, translate a foreign language, or pitch a baseball.

Of course, some things you learn to do can be measured by more than one of these yardsticks. If you were asked to learn a series of dates in history, you could check yourself by counting the number of dates remembered correctly, or by counting the number of mistakes you made in reciting the list, or by timing yourself to see how long it takes you to produce the list correctly.

You will find that nearly all the learning you do will be judged in terms of one or more of these measures of learning. To state the principle in another way, we may say that it is difficult to demonstrate that any learning has occurred unless we use one or more of these measures. Obviously, they can be applied at any time during the learning process. It is not necessary, for instance, for the student to wait until he recites in class or takes an examination for him to be able to determine just how far his own learning has progressed. The fact that we do so often wait until those times when performance is "for keeps" is simply a reflection of how seldom we have been checked in the past. In college, you are judged in terms of what you can demonstrate in the many test situations that go with every course. No one cares very much about what you say you know or what you think you know or what you ought to know. The question that is continually being asked of you is: "What *do* you know?"—and you are given some rather definite ways of proving yourself.

Criterion of learning

Another bothersome question that always arises when we stop to examine the learning process is this: "When may we consider a performance learned? When may we stop the practice with assurance that a habit has been established?" If you stop to think about it seriously, you will probably arrive at the same answer that psychologists have. The safest answer to this question is: "It depends!" It depends upon many, many factors, all of which are included under the heading of the *severity of the criterion.* Sometimes the criterion of learning is set by the task itself. We might say that a man had not learned to operate a machine in a factory, for instance, until his performance had reached the point that the machine was operated continuously, smoothly, and without damage to the operator or the material he was working with. On the other hand, we might allow the operator to make a few errors, to spoil a few pieces, or to allow the machine to get ahead of him once in a while and still call him an "expert" operator. In the latter case, we have modified the demands of the task by our own requirements. The point is that, in either case, it could be said that the man had learned to operate the machine.

To bring the problem a little closer home, we can point to the student who would like to know when he can consider his history lesson learned. The answer to his question is still: "It depends." What degree of perfection will be required or is desired? How long must it be remembered? In what form will he be held responsible for it? The answers to these and other questions will vary from student to student and from course to course. THE POINT TO REMEMBER, HOWEVER, IS THAT THE CRITERION OF LEARNING IS ALMOST ALWAYS ARBITRARY.

Except in those instances where the standards are dictated by the task itself, the criterion is subject to change according to any of several outside conditions. Suppose the student tells us that perfect reproduction of the material learned is the desired goal. Learning, then, must proceed until he is able to reproduce the material without error. But, as we shall learn later, forgetting begins immediately after practice has ceased.

If the student learns his material to one errorless reproduction, he may expect it to be of little value to him in that form, except for immediate recall. If two or three, or five or ten, errorless reproductions are used as the criterion of learning, he will find that, with each increase in the severity of his standard, forgetting will proceed more and more slowly. Once an arbitrary criterion of learning has been established, repetitions beyond this point are called *overlearning*. Our principle may, therefore, be stated in this way: THE CRITERION OF LEARNING IS ARBITRARY. THE SEVERITY OF THE CRITERION, TOGETHER WITH THE AMOUNT OF OVERLEARNING, DETERMINES THE RATE AT WHICH FORGETTING WILL TAKE PLACE.

The practical applications of this principle should be fairly obvious. You may find that the chief reason why so much of what you learn seems not to "stick" may be simply that it was not really learned in the first place. There are other determiners, of course, such as set, emotional blocking, and so forth, but we are interested now in the degree of learning. In the preceding paragraph, we mentioned the student who learned his history lesson to one errorless reproduction. Even this criterion of learning is not very severe, and we should not expect such a student to remember all he had learned for more than a few minutes after he stopped practicing. You may find that your own criterion of learning in much of your study is even less demanding than this. How often do you require yourself to study until you can reproduce perfectly what you have studied? Usually, a student will set as his standard some such measure as the number of times of rereading or the amount of time spent in study. As we have already seen, such standards may indicate absolutely nothing as to the actual amount learned or the degree of perfection attained.

Economies in Learning

Immediate recall

We have just stated that the task may be to remember the material read or heard for a very brief period. This occurs very frequently every day. You go into a restaurant and order

lunch. As you look over the menu, you decide that you can afford the forty-five-cent special. When you pay the cashier, you have to glance at your check to see how much you owe. If someone asked you a moment later how much your bill was, you might not be able to tell him. It simply is not necessary to remember such details.

Too many users of the telephone are incapable of reading a six-digit number in the directory and of retaining it long enough to dial it correctly; hence, the use of names as substitutes for digits. It is easier to remember Walnut 3746, even though it may be more difficult to find WA on the dial than two corresponding digits 92. It is also easier to remember the digits if they are subdivided, as 37–46.

Another practical example of this so-called *memory span* is the ability to take notes in class. If the professor wishes to dictate a statement that he considers important, how many words can he dictate without pause and be assured that the class will get it all? You will observe that some students immediately begin to copy from their neighbor; others are lost after a half-dozen words, while a few can retain a long sentence. Or, observe an expert stenographer. She continues to write long after the dictation has ceased. This points to an important fact. She has *learned* to listen to or to grasp the material in larger units, rather than at the rate of two or three words at a time. Those who fail: (1) have not acquired the skill of being ready or set for the first words; (2) react slowly to what is spoken; and (3) attempt to react to each separate word, rather than to the whole sentence. It is also probable that a shift in posture when they start to write obliterates the material just learned.

Length of material

Another factor that will determine the amount of practice required to attain any given level of learning is the amount of material to be learned. This problem occurred to one of the first experimental psychologists, Ebbinghaus, who reported a series of experiments on learning in 1885. He devised what are known as *nonsense syllables,* in order to ensure uniformity

of material for all subjects. These syllables consist of two consonants with a vowel between. All combinations of such letters that form meaningful words are discarded, since meaningful words would have the disadvantage that some are more familiar to the subject than others. The object is to set up series of syllables of unequal length, and to eliminate insofar as possible unequal difficulty by selecting syllables that do not have pre-established associations. Ebbinghaus used one errorless reproduction as the criterion of learning, and all lists were learned up to this standard. One errorless reproduction was considered by him as the *threshold of learning*—that is, the

TABLE XII

NUMBER OF REPETITIONS REQUIRED TO LEARN NONSENSE-SYLLABLE SERIES OF DIFFERENT LENGTHS
(After Ebbinghaus)

Number of Syllables	*Number of Repetitions*
7	1
12	17
16	30
24	44
36	55

material could be considered as just barely learned. Since he was interested in the effect of the length of material upon the amount of time spent in learning, he could select any criterion he chose, as long as all of the material was learned up to this standard.

This material should be presented to the learner at a uniform rate. For this purpose, it is usual to employ some type of automatic exposure apparatus that will expose one syllable at a time. The subject reads the syllables as they come into view, until he is able to repeat the entire list once correctly. This is taken as the threshold of learning.

Ebbinghaus' results are given in Table XII. It will be observed that, as the number of syllables to be learned increases, the number of readings necessary to learn the series increases disproportionately. If twelve syllables require seventeen read-

ings, twenty-four syllables ought to require thirty-four readings. This is not the case. WE MAY CONCLUDE THAT AN INCREASE IN THE AMOUNT TO BE LEARNED DOES NOT ENTAIL A CORRESPONDING INCREASE IN THE TIME REQUIRED FOR LEARNING.

Whole versus part learning

One might infer from the results in Table XII that it would be better to break up the material to be learned into smaller units. That is, if you wish to learn a poem of four stanzas, would it not be easier to read the first stanza until it is mastered and then learn the next, and so on? Unfortunately, the experimental results are not clear in this case.

In one investigation,[1] it was found that, even though long poems were used, the whole method was superior and that the saving increased as the length of the poems increased. A 240-line poem was learned by the whole method with a saving of 20 per cent over an equivalent amount learned by a part method. In another experiment, in which both poems and nonsense syllables were used, it was found that the whole method was 9 per cent better than the part method; but for nonsense syllables, the results were at first reversed. Further practice with nonsense syllables, however, gave practically the same results as were obtained with poems.

Other investigators have obtained opposite results. One divided school children into two groups of equal age and learning ability, determined by preliminary learning tests, and gave one group poems to learn by the whole method and the other group the same poems to learn by the part method. He found the part method showed an advantage of twenty-six per cent over the whole method.

Variations of the part method. If you have a poem or similar verbal material to learn, you might employ any one of several part methods. You might, for instance, attempt to learn the first few lines and then add a line or two at a time, until the entire poem was finished. This is known as the *pro-*

[1] Pyle, W. H., and Snyder, J. C., "The Most Economical Unit for Committing to Memory," in *Journal of Educational Psychology* (1911), Vol. II, pp. 133–142.

gressive part method. In one investigation, the following part methods were tried:[2]

1. *Pure part.* Learning each section separately and then repeating the whole.

2. *Progressive part.* Learning section 1, then section 2; then combining sections 1 and 2 together, then section 3; and so on.

3. *Direct repetitive.* Learning section 1, then repeating sections 1 and 2, then adding section 3, and so on.

4. *Reversed repetitive.* Learning in the order of section 4, then section 3, and so on.

In this experiment, both rats and human subjects learned a maze. At first thought, it would seem a far cry from learning poems or nonsense syllables to learning to run a maze. As a matter of fact, it has been found that the learning process is very much the same, regardless of the material, so long as we are considering purely rote learning. It is also true that animal subjects make convenient and generally reliable substitutes for human subjects.

The maze was designed in four parts of equal length and equal difficulty. It was so arranged that any part could be made to lead to the food box for the rats, or two or more adjoining parts could be connected so that the subject could go from the end of one part into the beginning of the next. In some of the experiments by the whole method, the subjects were allowed to retrace as far as they wished. In others, they were allowed to retrace only within the limits of a single section, as would be possible if they were learning section by section.

Table XIII gives some of the results. If we consider only the results of the human subjects, we may conclude that the progressive part method is superior, both from the standpoint of the number of trials required and the number of errors made during the learning. The whole method, with returns pre-

[2] Pechstein, L. A., "Whole versus Part Methods in Motor Learning," *Psychology Monographs* No. 99 (1917). Vol. XXIII.

vented, ranks second so far as errors are concerned, although more trials were required than in some of the other methods. The results of the rats were very similar to those of the humans. When we consider that the results of all the experiments deal with those problems relative to the merits of the whole and

TABLE XIII

WHOLE VERSUS PART LEARNING FOR RATS AND HUMAN SUBJECTS
(After Pechstein)

Method	*Number of Rats*	*Average Number of Trials*	*Average Time in Seconds*	*Average Total Errors*
Progressive part	9	11	662	65
Reversed repetitive	8	17	882	76
Direct repetitive	11	21	1,442	142
Whole—returns prevented	9	30	1,666	111
Pure part	9	30	1,907	199
Whole—returns allowed	12	27	4,174	217
Method	*Number of Human Subjects*	*Average Number of Trials*	*Average Time in Seconds*	*Average Total Errors*
Progressive part	6	10	352	57
Reversed repetitive	6	22	1,014	226
Direct repetitive	6	11	618	96
Whole—returns prevented	6	17	541	81
Pure part	6	23	1,220	126
Whole—returns allowed	6	12	641	237

various part methods, we are unable to draw any clear-cut conclusions that would favor one method or the other as a universally best method. Other experiments similar to these have been performed and the results related to such factors as intelligence, level of comprehension, and other characteristics of the learner. The results from these experiments are also am-

biguous in many respects. We can, however, make a few tentative inferences:

1. If the subject is capable of comprehending the material and of relating it as an integral unit, the whole method will probably be superior.

2. Closely related to this comprehension is the degree of maturity and intelligence of the subject. The whole method will be of greater advantage to the more intelligent or mature subject.

3. Whether one will learn better by one method than by another depends upon his previous habits of memorizing.

4. Some parts of any assignment may be more difficult than the rest of the material. It is a waste of time to read the whole assignment over and over until the difficult passages are mastered. It is more economical to expend more time and effort on the difficult passages, and then link them up with the rest of the material. Too often, the student fails because, according to his own reports, he "reads over" the assignment several times.

5. Finally, it should be realized that learning is a matter of organization of material and that it involves "investment." Unless the investment of time and energy is made, the returns will not be forthcoming. This investment should be made economically to ensure the greatest returns. Some students seem to get a greater return for the amount invested, but on the whole it is the shrewd investor, as in finance, who gains the reward for his labors.

Distributed versus concentrated practices

If the results of experiments on part methods of learning are equivocal, this is certainly not true in the experiments dealing with the effect of distributing the time spent in learning. Under ordinary conditions, it is found that it is definitely better to spend a little time each day in learning than to attempt to learn the material all at one sitting. For example, two subjects read series of nonsense syllables twenty-four times. One series was read eight times on three different days; another, six times for four days; and a third, twice for twelve

days. Table XIV gives the results. It is clearly evident that, so far as this experiment goes, the greater the distribution, the greater the number of syllables remembered when they were tested. Of course, we do not expect that this relationship between spacing and learning will continue indefinitely. If the experiment had been continued with other series which were read once on each of twenty-four days or once every other day for forty-eight days, a place would have been reached beyond which further spacing of the readings would have no beneficial

TABLE XIV

EFFECT OF DISTRIBUTION OF REPETITIONS ON ECONOMY OF LEARNING

Recitations per Day	*Number of Days*	*Syllables Remembered*	
		Subject M	*Subject B*
8	3	7	18
6	4	39	31
2	12	53	55

effect. As a matter of fact, IF THE TIME BETWEEN THE READINGS BECOMES TOO GREAT, LEARNING MAY NOT OCCUR AT ALL.

In another experiment, the subjects were required to translate a code of letters into a corresponding code of numbers. As they became more familiar with the code, they would be able to write more numbers in the time allowed for the task. Their learning would therefore be measured by the improvement indicated in the amount transcribed. One group of subjects worked 10 minutes twice a day; the second group, 20 minutes once a day; the third group, 40 minutes every other day; and the fourth group, 120 minutes at one sitting.

The results of these experiments are summarized graphically in Figure 71. The fourth group, which did all the work at one sitting, improved very little. On the other hand, the groups that worked twenty minutes each day, either in one or two sittings, made the greatest improvement.

In an experiment that more nearly represents the classroom situation, students read a passage of 1,550 words either 4 times

at one sitting or once a day for 4 days. Then, they were given a true-false examination on this material. It was found that the distributed method gave better results than the concentrated readings. However, it was further found that an interval of 3 hours between readings was as good as a day's interval. On the whole, we may conclude that there is an advantage in distributing your work, rather than letting

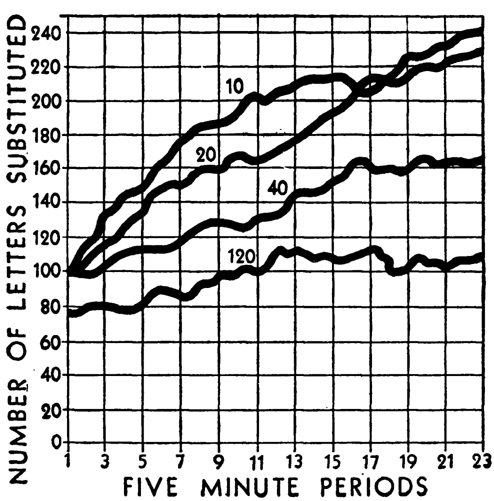

Figure 71.—Practice in Writing Numbers for Letters According to a Key. (*Starch.*)

it go to the last minute and concentrating upon it all at one study period. Not only do you learn more by the distributed method, but it is retained longer.

If a little slogan will help you to put this principle into practice, try this one: "Study at least a little bit every day on every subject or course you are taking." The psychologist can give you almost a "money-back" guarantee of improvement in your work if you put this principle into practice. Of course, it will be a little hard for you to do it faithfully. It will require that you set aside a period each day for every course you are taking. There are many things that you can do during these sessions: you can copy lecture notes; review material you once knew to be sure that you still know it; read ahead a little in the text;

and commit to memory some of the factual material, such as vocabulary, formulas, and laws. On some days, of course, you will want to spend more time on certain subjects, but you will be amazed at the absence of the need for those all-night sessions just before examination time. Most of us realize that cramming is an inefficient way to study. All we need is a little urging and planning to rid ourselves of the necessity of doing it.

Just why the distributed method should prove more economical is not entirely clear, although several explanations are offered:

1. One suggestion is that spaced study periods eliminate fatigue and boredom. If you have read a chapter once, it is rather a bore to go back and read it over again immediately. If material is not to be repeated verbatim, it is not advisable to learn it by simply reading in the same manner at each repetition. Therefore, the factor of fatigue and boredom seems to be one consideration as an explanation of the advantages of the distributed method.

2. A second explanation that has been given is that the intervals between readings permit perseveration or consolidation of the material just read. This signifies that something goes on after the exercise that may be thought to be the continued activity in the nervous system or some organizing process that makes the learning more effective. If the second reading follows immediately upon the first, the full benefit of this consolidation process is not realized, since it has no opportunity to occur.

3. A third explanation claims that, during the interval between practices, errors are forgotten more rapidly than the successes. It does seem to be true that often we fail in a performance because we get the wrong slant on the material and keep repeating the same errors over and over. Years ago, William James, one of the early outstanding psychologists in this country made the observation that we learn to skate in summer and to swim in winter. This was before the indoor skating rink and swimming pool, of course. His thought was that we consolidate our gains from practice of swimming during the summer while we are not swimming during the winter. No doubt,

all three of these factors play a part in strengthening the learning process when we use the distributed method.

We learn by doing

In a lecture course, a professor observed that one student took no notes but seemed to listen attentively to the lecture, while the man who sat beside him was writing assiduously. Time after time in the examinations, the student who took no notes did much better than the other student. At the end of the term, conversation with the two students revealed that one attempted to take the entire lecture in shorthand, while the other listened in order to fill in omissions in the shorthand record. Barring the fact that the student who merely listened may have been more intelligent than his associate, it would seem that he gained more from the lecture because he was constantly organizing the material in order to be able to fill in these gaps in his partner's notes at the later period.

Two students of nearly equal ability were registered in a law school and took the same courses. One student was blind; the other did all the reading for both of them. When they graduated, the blind student was second highest in his class, while his reader graduated with an average record. Admitting that other factors may also have been operative in this case, we have here a nice illustration of how little real learning may accompany mere passive performance.

A similar experience is reported by a prominent professor of psychology, who relates his failure to learn after years of reading the same material.[3] He states that it was his custom every morning to read the morning prayer provided by the Episcopal Church. He estimated that, in the course of 25 years, he had read this prayer approximately 5,000 times, usually at 24-hour intervals. He realized that he was still unable to repeat this service, because at times he became confused in turning a page while he was reading. Consequently, he set himself the task of testing his memory of the prayer by

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[3] Sandford, E. C., "A Letter to Dr. Titchener," in *Studies in Psychology*. Contributed by colleagues and former students of Titchener (Worcester, Massachusetts: Louis N. Wilson, 1917), pp. 8-10.

looking at the first word and then writing from memory others he could recall. When he had written as much as he could remember, he would prompt himself by looking at the next word and then again write as much as he could. Table XV is his record.

TABLE XV

A TEST OF MEMORY AFTER 5,000 PASSIVE READINGS

Number of Words in Prayer	*Number of Promptings Required*	*Average Number of Words Recollected*
(II) 124	44	3.0
(III) 73	20	3.6
(IV) 146	38	3.8
(V) 158	27	5.8

This table does not include the first and last prayers that made up the service. The first was the Lord's Prayer, which he had learned as a boy and at one time could recite without prompting. The last (VI) prayer was the benediction, which he had committed to memory intentionally at an earlier period. The difference in his ability to repeat the first and last prayers as compared with the others (II to V) is significant. He had read the first and last with the intention of learning them, but his reading of the middle group had been purely as an exercise in reading.

Very frequently, students complain that they do not understand why they are unable to do better in their studies. When questioned as to their method of study, they almost invariably make the statement that "they read the material over" 4 or 5 times. We have just seen that one might read over the material 5,000 times and still not know it.

Learning requires action of some kind. For example, it is a good thing to read over the material in order to get a general impression of what it is all about and then to begin to search for details, and with each reading organize the material, rather than passively to read it over. If the material must be learned verbatim, it is wise to read and then attempt to recite. In one

experiment [4] of several dealing with this method, students were required to learn series of sixteen nonsense syllables or a seventy-word biography. One group read the material until it was learned and then was tested, four hours later. Other groups did the same thing, except that they interspersed recitations that took the place of part of the readings. Table XVI shows the schedule and the results for both types of material.

It will be seen that, for learning without recitation, the amount recalled after four hours was considerably less than

TABLE XVI

RELATIVE EFFICIENCY OF FIVE SCHEDULES OF READING AND RECITATION

Percentage of Time Spent in Recitation	*Percentage of Nonsense Material Recalled*		*Percentage of Sense Material Recalled*	
	Immediate	*After 4 hours*	*Immediate*	*After 4 hours*
0%	35%	15%	35%	16%
20	50	26	37	19
40	44	28	41	25
60	57	37	42	26
80	74	48	42	26

for the groups that devoted a part of the time to attempted recitation. Even as much as eighty per cent of the time devoted to recitation proved to be the most efficient. This investigator suggests that the superiority of the recitations is due to the fact that it furnishes a goal toward which the learner can work. It also gives him an opportunity to discover what parts he knows and those parts he does not know. Furthermore, merely reading emphasizes the isolated elements to be learned, while recitation favors the organization of the material into a complete whole.

Note taking while reading, when the material is not to be learned verbatim, has a similar advantage, *provided* that the student does not merely copy isolated statements from the text. If he attempts to organize the material, listing the important

[4] Gates, A. I., *Psychology for Students of Education* (New York: The Macmillan Company, 1924), pp. 269–271.

facts and conclusions under the proper headings, the very fact that he is taking an active, participating role in his study increases the amount he learns in each contact with the material. This procedure, if faithfully followed, will mean that a great deal of study time will be spent with the textbook closed. Before an entry is made in the outline, the student reads the material until he understands it and then makes the outline *in his own words.* The remainder of the study time is spent in assuring himself that he knows his outline. This must be done also by the recitation method. READING AND REREADING AN OUTLINE IS NO GUARANTEE THAT YOU WILL REMEMBER WHAT YOU HAVE READ. Sometimes this method of study is called the *question-and-answer method.* It is another method that guarantees results.

One of the great handicaps of the college student is the social environment in which he is living. He deals with his courses in the classroom and during the study hour, but rarely discusses them when with his fellow students. The nearest approach to a discussion of the subject matter of his courses is an occasional comment regarding grades on the last quiz or some frivolous remark regarding the instructor or the other students. It is difficult, therefore, for the student to experience the application of the material in everyday life situations or to discuss the problem of learning, for example, over the table in a refreshment parlor. The more frequently a student comes in contact with various elements in the subject he is studying, the easier it is to integrate the material and make it more permanent. Actually, what is happening is that every time a student makes some application of what he has learned or discusses it with a classmate, he is practicing the performance he is trying to learn. As we have seen, PRACTICE IS AN IMPORTANT ASPECT—ALMOST A REQUIREMENT—OF LEARNING; AND THE MORE ACTIVE THE PARTICIPATION IN THE PRACTICE, THE GREATER THE BENEFIT DERIVED BY THE LEARNER.

Motivation in learning

We have already stressed one important factor in learning, namely, the intention to learn. This implies that the individ-

ual has a goal. He is motivated to learn because there is an object in view. One difficulty in the student's career is that too often he does not see the value clearly; the goal is too far in the future. For this reason, grades have been substituted. This has the disadvantage that the student may work for grades and lose sight of the more distant objective: the cultural or practical value in his future life of the course he is now taking.

Working for grades, however, is infinitely more desirable than simply putting in one's time because one has been told to do so. The college experience would be an interesting, though expensive and useless, adventure if students took only those courses they liked or could see some immediate use for. In spite of the number of required courses now included in most curricula, alumni are continually saying that they wish someone had made them take certain courses that they skipped in college either because they had a reputation for being difficult or because they seemed to have little practical value. A prospective teacher is less interested in a course in general psychology than in a course in education, because the latter seems to be more intimately related to his chosen profession. A student in engineering or in medicine likewise fails to recognize the importance of the course in physics or in anatomy. These are natural difficulties. The more we see the importance of the material to be learned, the easier it is to adjust to the learning situation. WE MUST BE REWARDED IN SOME FORM FOR OUR EFFORTS, AND THIS REWARD (OR PUNISHMENT) MUST OCCUR RELATIVELY SOON AFTER THE PERFORMANCE THAT IS BEING PRACTICED.

Recently, a professor of botany related that, in his first course, students were given careful instructions for three days in the use of the microscope. At the end of that time, they could use microscopes more effectively than at any later time during the term or in the succeeding course. An examination of the situation revealed that, during these first three days, the student was carefully checked on his successes and failures. We may call these *rewards and punishments*. After that time, it was assumed that he knew how to use a microscope and was

left more to his own devices. To regain the original efficiency in the use of the microscopes, the system of rewards and punishments would have to be reinstated—at least, until the skill had become more of a habit than three days of practice would permit.

In an experiment with animals, this principle is similarly revealed. Two groups of white rats were run in a maze. In one group, the rats were given no reward during the first ten days, after which they were rewarded with a bit of food at the end of each run through the entire maze. The rats in the second

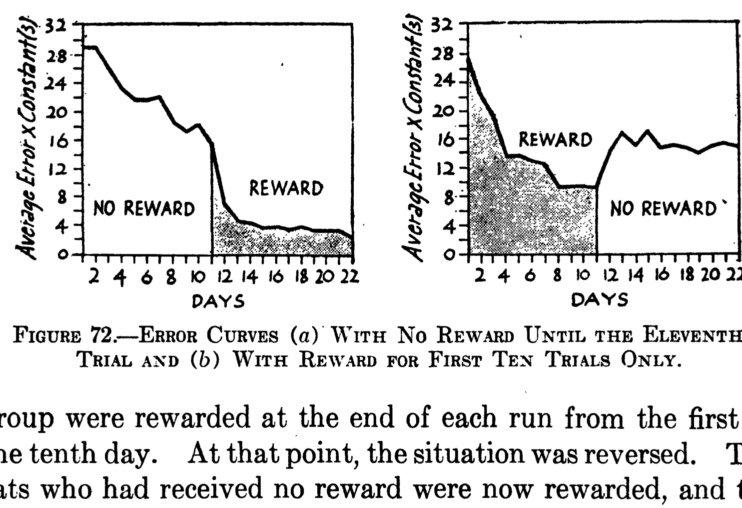

FIGURE 72.—ERROR CURVES (*a*) WITH NO REWARD UNTIL THE ELEVENTH TRIAL AND (*b*) WITH REWARD FOR FIRST TEN TRIALS ONLY.

group were rewarded at the end of each run from the first to the tenth day. At that point, the situation was reversed. The rats who had received no reward were now rewarded, and the others received no reward. An examination of Figure 72 indicates that, although there was some learning during the unrewarded period, it was less than with the rewarded group. When the situation was reversed, the previously unrewarded group improved more rapidly with the reward; and the previously rewarded group, like the botany students, failed to do so well as they had done in the latter days of the rewarded period.

Cramming for examinations has its only advantage in the fact that the goal is near at hand. It is much more difficult to start industriously at the beginning of the term, even though one has good intentions, than it is when the day of reckoning is near. Term papers, collateral reading, review—all pile up in

the last two weeks. This point is illustrated in another experiment with animals: [5]

White rats were placed at one end of a long, straight runway, and had to travel to the other end to secure food. At regular intervals were swinging doors, which recorded the passage of the rat. In this way, the time of travel in each section was recorded. It was found that the speed of the rats increased constantly up to the last section. This corresponds somewhat to the student's efforts during a term. If it were not for occasional check-ups during the term, the lag would be still greater. Each quiz or examination, or date set for a term paper is a goal that acts upon the student to increase his application. IF THERE WERE NO REWARDS AND PUNISHMENTS, THERE WOULD BE LITTLE, IF ANY, LEARNING. All through life, we are learning to avoid objects and situations because our behavior brings pain or reward.

Another fact of importance is our purpose in learning, or the time and use that we are going to make of what we learn. If you wish to make a telephone call, you look up the number and learn it long enough to dial. If you were asked after your call is completed what the number was, in most cases you could not repeat it. Cramming for examinations is often in the same category. The student attempts to remember the material for the specific need during the examination period. In one case, the final examination of the first term was repeated at the beginning of the second term. The results revealed that not more than half of these students could have passed the course on this second examination. IT IS GENERALLY FOUND THAT MATERIAL THAT IS LEARNED FOR THE PURPOSE OF BEING USED A WEEK LATER WILL BE RECALLED LESS COMPLETELY THAN MATERIAL THAT IS LEARNED FOR A LONGER PERIOD WHEN BOTH ARE TESTED AT A LATER TIME.

Teaching and learning

It is generally recognized that the teacher has something to do with the subject's progress in learning; otherwise, there

[5] Hull, C. L., "Speed of Locomotion Gradient in the Approach to Food," in *Journal of Comparative Psychology* (1934), Vol. XVII, pp. 393–421.

would be no profession of teaching. If you desire to learn to play golf, you engage a professional or get a friend to give you lessons. In any act of skill, as well as in academic subjects, the learner progresses more rapidly if he has a good instructor. Teaching consists in maintaining a strong motive in the learner and in directing his activities in the proper skills. This directing of the learner's activities is really a process of restriction. No amount of teaching will produce learning. It simply directs the activity into the proper channels. It also may furnish criticism and example from which the learner may profit. Too much teaching may interfere with learning, rather than aid it.

It is also important to know whether instruction should be early in the learning process or late. In one series of experiments,[6] both rats and humans were used as subjects in a maze-learning situation. They could be forced into the correct pathway by means of a mechanical device. Varying numbers of "guided" trials were introduced at the beginning, the middle, or near the end of a series of unguided runs through the maze. With both rats and human subjects, substantially the same results were obtained. The learning was most effective when a small amount of guidance was initiated at the beginning, and was slightly less effective near the end. If a great deal of guidance was given, it had a negative effect upon the learning. It would appear, therefore, that a teacher can teach "too much." The skillful teacher will make the proper balance between what he does for the benefit of the student and what he requires the student to do for himself.

Acquisition of Skills

Verbal and manual skills

It is a popular notion that there are two kinds of learning: mental and motor. We have treated the learning of poems and the learning of mazes as if they were of the same sort. Really,

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[6] Carr, H. A., "Teaching and Learning," in *Journal of Genetic Psychology* (1930), Vol. XXXVII, pp. 189–219.

the only distinction, so far as the principles of learning are concerned, is that learning a poem is done verbally, while learning a maze—in the case of the human subject—is done manually. He traces the maze with his fingers or hand. Even this is sometimes accompanied by talking to himself as he learns, so that his learning is inseparably both manual and verbal. The rat walks or runs through the maze. The difference, however, is that the motor types of learning involve explicit performances which yield to the subject evidences of his success and failure that are not always recognized in verbal learning, particularly when this is silent and involves only implicit responses. Studies in acquisition of skill in shooting with the bow and arrow or rifle, or in learning to play golf, all illustrate the fact that the acquisition of these skills is very much the same as the acquisition of the ability to recite a poem or acquire more complex skills, such as a thorough knowledge of zoology or psychology.

Studies in the acquisition of skill do point out many characteristics of learning on which we can establish some rather important principles. In a study of learning to operate the typewriter,[7] the subjects were required to practice regularly by the touch system. Their progress was very similar to that made in learning a long poem, but it revealed the factors that enter into becoming an expert typist. At first, their speed was very slow. They had to learn the position of the keys; each individual letter had to be picked out. In the second phase, they were concerned with hitting the keys accurately. Then, they began to anticipate the sequence of strokes used in familiar words. As one subject put it: "A word simply means a group of movements." Finally, they reached a point where phrases were similarly organized. At this stage, they were reading ahead of patterns of movement of their fingers. Expert typists copied behind the reading, thus saving time to organize the response patterns. This is a skill previously mentioned that students neglect to acquire when taking notes or

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[7] Book, William, *Psychology of Skill*, University of Montana Studies in Psychology, Bulletin No. 53 (1908), Vol. I.

short dictations in class, namely, to organize what the instructor is dictating while they write.

The plateau

Students who were learning telegraphy [8] were tested once each week for the number of words they could send and receive in several two-minute periods. The results of each series of tests were averages whereby their accomplishment could be determined week by week. Figure 73 represents the improve-

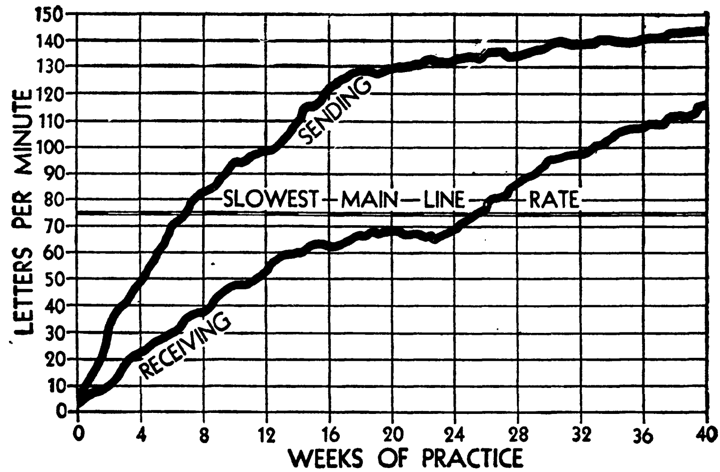

FIGURE 73.—PRACTICE CURVES IN LEARNING TELEGRAPHY. (*Adapted from Bryan and Harter.*)

ment of one subject for each of these weekly tests. It will be seen that the curve for sending rises rather rapidly during the first weeks of the practice and then seems to approach a limit; while the receiving curve rises more slowly until about the fifteenth week, when improvement appears to be at a standstill. At about the twenty-fifth week, the receiving curve begins to rise again; but it never reaches the level of the sending curve. The receiving curve does not rise so much as the sending curve because the experiment was not continued long enough. The

[8] Bryan, W. L., and Harter, N., "Studies in the Physiology and Psychology of the Telegraphic Language," in *Psychological Review* (1897), Vol. IV, pp. 27–53; (1899), Vol. VI, pp. 355–357.

rate of learning to receive is slower than the rate of sending. Experienced telegraphers can receive faster than they send. Therefore, at some time after forty weeks, the receiving curve would have crossed and exceeded the sending curve. There are, then, two outstanding features in learning telegraphy:

1. One can learn more rapidly to send than to receive code. It is easier to organize the response from the sending (reading) to the less familiar (code) than it is to adjust oneself to the unfamiliar (code) and respond with the familiar (writing).
2. Sending is a gradual process of learning that progresses rapidly at first, then more and more slowly; while receiving brings a period of no improvement—the *plateau*—followed by improvement.

It is quite frequent for periods of no apparent progress to be displayed during the acquisition of complex performances, such as telegraphy, typing, and golf. These same periods of no improvement can also be noted in learning a poem when the subject seems to have attained a fair degree of success and then stumbles over certain parts of the poem, and the percentage learned seems to remain at the same level. A number of factors may be responsible for this lack of gain:

1. The learner may lose interest in the project. He becomes discouraged and inattentive.
2. If the learning is done at one sitting, fatigue may be responsible for the lack of progress.
3. A more significant feature seems to be that the progress represents a consolidation of tasks one of which has to be acquired with more than moderate facility before the rest can be organized with it.

An interpretation of the receiving curve before us, therefore, would seem to hinge upon this last possibility. The subject has learned the code well enough so that he can receive individual letters at a higher rate of speed, but as yet has not organized these codes into a pattern representing words. Until he has practiced enough to be able to make such organization, his speed of receiving remains at the same level. When, how-

ever, a series of dots and dashes means words rather than letters, his efficiency again begins to increase. Further improvement would involve his being able to handle whole sentences as units. Because one subject exhibits a plateau in his learning curve is no reason to assume that every other learner will do the same. He may begin to attack the problem of wholes at an earlier period and fuse the various elements, rendering his learning curve smoother but ultimately reaching the same level of attainment.

This problem of small and large units in the task was analyzed in a simple experiment of tossing two balls with one hand. If you will try to do this, you will recognize that there are three important factors involved:

1. *The control of force or the distance the ball is tossed.* It must be tossed high enough to allow time to catch the other ball and get it into the air before catching the first one.

2. *The direction.* If the one ball is tossed straight up, the second ball will interfere with it. If it is tossed on too great an angle, the subject has to reach too far to catch it after tossing the second.

3. *Timing so that the hand may be closed to catch the ball.* Actually, the subject must watch the course of the balls after they are tossed. Consequently, the descending ball passes out of the field of vision before it strikes his hand. If he waits until the contact before closing his hand, the ball will bounce off.

When separate experiments, each representing one of these elements, were performed, no plateau appeared. When the subjects practiced ball tossing and other complicated acts, some subjects exhibited plateaus, while others did not. It was found that the plateaus occurred when the subject concentrated on one element. As in the telegraphic code, his degree of success was limited until he had mastered this sufficiently to take up the next task as an addition to the first. In other subjects where plateaus did not appear, they devoted themselves to the task as a whole, rather than to its specific elements. In studying in a college course, the student may devote himself to

vocabulary and fact, and show considerable progress for a time. Then he begins to fall behind, because he is not yet able to make generalizations and to apply these generalizations to practical situations. This does not mean, of course, that his periods of no progress are not also influenced by shifting motivation and various distractions, as well as health, fatigue, and so forth. Knowing the causes of these plateaus, we may expect them to occur and can take steps to prevent them if their occurrence in some particular task is undesirable.

Transfer of Training

Another popular notion regarding learning, particularly with reference to college education, is that it is a "training of the mind." Many employers will hire a college graduate without considering what subjects he has studied, simply because they believed that a college education has trained the applicant to greater mental ability, which may be used in any field. There is a certain amount of truth in this assumption. In the first place, the college course has been a series of tests and examinations or hurdles; and, in general, the less fit have fallen by the wayside. Therefore, the college graduate is to be considered superior to the nongraduate. This superiority may be due to his original ability as well as to the training he has received.

But the assumption goes further than this in many cases: A generation ago, it was generally believed that a study of the classics was a formal discipline that rendered the student more capable in any other field. Investigations in recent years, however, have indicated that there is no clear demonstration of this formal transfer from one subject to another. There are, however, a number of ways in which a study in one field becomes an advantage in another field, and also instances in which this training in one subject may work to the disadvantage of learning another subject. What one does transfer from one field to another is methods of attacking a problem and the degree to which these methods are transferable when they depend very largely on the subject's attitude in learning the first material and his ability to use in the second field the lessons that he has learned in the first.

Cross training

If we take a simple case of learning and transfer, such as the use of the right hand for an act of skill and the later effect upon the use of the left hand for the same skillful process, we see that there is a high degree of transfer. A simple experiment in the laboratory is to trace a figure seen only in the mirror. For example, the subject may be required with free hand-and-arm movement to trace with a pencil the outlines of a six-pointed star so arranged that he cannot see his hand or the figure, except in the mirror placed vertically before him. The tendency is to make a movement away from him when he ought to make it in the opposite direction. After some thirty trials, he is able to trace the star with little hesitation. If, now, he uses the left hand and traces the star in the same direction, he will do much better than on the first trial with the right hand and will, with very few trials, be as skillful in the next trial as he was with his right hand. He has learned that up is down and down is up, and numerous other elements of the test. Although his left hand has not actually performed the task, he has been reacting to the total situation.

Transfer in organizing

To take another illustration, if our subject practices learning poetry, he will improve with each new poem learned, because again he carries over certain principles that he has acquired in the learning process. But this learning will generally not influence his ability to learn other types of material. In learning the poetry, he has learned to make use of rhythm, to organize the material, as well as other aids that he has hit upon. This feature of the transfer is illustrated by an experiment conducted with three groups of subjects: [9]

One group, the control, was tested before and after a three weeks' interval. A second group devoted a total of three hours, divided into eight periods over the three weeks, to memorizing

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[9] Woodrow, H., "The Effect of Type of Practice upon Transference," in *Journal of Educational Psychology* (1927), Vol. XVIII, pp. 159–172.

poetry and nonsense syllables. The third group spent the same time as the training group in the memorizing exercises, but were given instruction. It was pointed out to this group that the following rules as to the proper methods of learning would be helpful:

1. Learning by wholes.
2. Use of active self-testing.
3. Use of grouping and rhythm.
4. Attention to meaning and use of images, and symbols embodying meaning.
5. Mental alertness and concentration.
6. Confidence in one's ability to memorize.
7. In certain cases, as in learning nonsense syllables, the use of secondary associations—that is, the attachment of meaning to the nonsense syllable.

The tests before and after this training period for all three groups consisted of the memory span for consonants, Turkish-English vocabulary, dates, poems, and prose. It was found that the training group did no better on the second test than the control group, but the group that was instructed during the training period in the principles to be followed showed marked improvement. THERE IS NO EVIDENCE AS TO WHICH OF THESE RULES WAS MOST IMPORTANT, BUT THE GENERAL CONCLUSION MAY BE DRAWN THAT WHAT IS TRANSFERRED IS METHOD OF ATTACK UPON THE PROBLEMS.

The Effect of Age on Learning

In the previous chapter on maturation and learning, we saw that the ability represented by an intelligence test increased rather rapidly with age up to approximately sixteen years, and that ability as represented by greatest work reached its height in the thirties and then slowly fell off during the remainder of life. Attempts have been made to determine more specifically the growth of ability to learn as distinguished from general intelligence and accomplishment, and also as distinguished from the accumulated training that would influence

later learning. The curve in Figure 74 is suggested as a fair generalization of the relation of age to learning ability in human subjects. It must be remembered, however, that such a curve is based upon a variety of experiments and is not an absolute representation of the effect of age on learning ability. One method is to submit groups of subjects at different ages to a test of their ability to learn nonsense syllables. It must be recognized, in such a test, that the younger groups may be

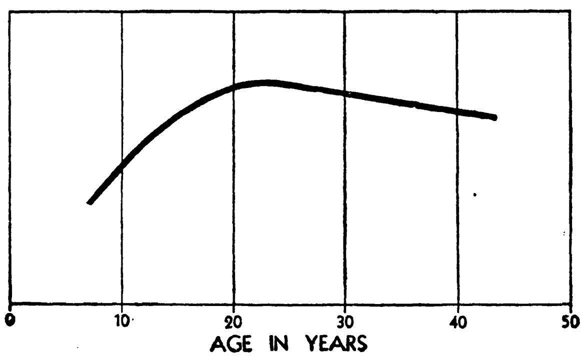

FIGURE 74.—THE GENERAL FORM OF THE CURVE OF ABILITY TO LEARN IN RELATION TO AGE IN HUMAN SUBJECTS. (*Thorndike.*)

more highly motivated than individuals forty or fifty years old would be. In other materials, the subjects at the later ages may be better prepared. They already have learned significant elements that apply to these tests. Another factor that must be taken into account is that the older subjects, on the whole, are probably more intelligent than the younger groups because of their survival—that is, it requires some intelligence to live to be forty or fifty years old. We may presume that the less intelligent, on the whole, die because of inability to take care of themselves, to eat properly, to avoid accidents, and to look out for possible illnesses.

Viewed from another angle, is the older student more capable of learning than the younger student? Here again, we meet with a selective factor. In general, the college freshman of sixteen or eighteen years must have more intelligence than the average in order to reach college at that age. On the other

hand, a young man may have worked three or four years before coming to college. Assuming an equal intelligence at the start, will he be handicapped as a freshman? The fact that he has lost contact with academic pursuits will be against him. But undoubtedly he has learned many things during his years of employment, and has matured physiologically to a point that ought to be in his favor.

What about the ability of your parents to learn as compared with your own? Students often feel that their parents are losing out because they are old at forty or fifty. It is true they refuse to accept some of the new things that their children learn with facility. There is no evidence, however, that this is due to declining ability or physiological deterioration. Old habits and lack of interest in the same things that interest the youth may interfere with their learning of the new; but this is no evidence that they could not learn as rapidly as their sons and daughters if they were properly motivated. They also have to their advantage greater skills in learning some types of material, at least, than have those of the younger generation. This is a specious argument because, at present, we do not have the data for making satisfactory comparisons between two widely separated age groups as fathers and sons. Until longitudinal studies—following through the lifetime of a group of individuals, with adequate controls of changing social influences—are undertaken, can we be sure that we are comparing two widely separated ages, and not merely two widely separated societies.

Summary

Little reference has been made in this chapter to individual differences in capacity to learn. That was dealt with in Chapter IV. It was emphasized there that "intelligence tests" measured the individual's general attainment, or what he had been able to learn in an environment common to other individuals. It is accepted, therefore, that some learn more readily than others.

More specifically, we have seen that learning may be of any degree. You may learn for the moment; or you may learn

material so well that it may be remembered, with an occasional repetition, for the rest of your life. How well you learn will depend upon the motives or interests that are to be served. Much of your learning is the result of constant and immediate rewards and punishments. You are checked in your daily adjustments when you do the wrong thing, and your cause is advanced when you do the right thing. More remote rewards or goals are serviceable in learning when you are able to recognize that the job well done today will be useful in some later situation.

Some methods of learning are helpful. Day-by-day attacks upon your course work, keeping the material fresh by referring to it frequently—either by using it or by discussion with fellow students—is a good method. Testing your own accomplishment from time to time by trying to recite also helps. Time spent in study or the number of times you read the material is no criterion of your accomplishment in learning. Active participation is essential.

The evidence is not clear as to the age at which the greatest amount of learning is possible, but this much is certain: learning does not stop at any specific age. The person of middle age is still capable of learning, although he may lack the incentives in certain fields that are important to youth and is also partially handicapped by what he has already learned. The old habits are difficult to uproot. On the other hand, he possesses many habits that are helpful in learning new things. There is ample opportunity to use old knowledge in new situations and to adapt previously acquired methods of learning to learning the new material.

14

Remembering and Forgetting

Perhaps we are making an artificial division to consider remembering and forgetting in a separate chapter. Of course, we realize that learning depends upon remembering. Unless an individual remembers long enough to benefit from each practice, there will be no learning in the first place. Forgetting is considered by some as simply the mirror image of the learning process. Learning is the "burning in"; forgetting is the "fading out." Both *remembering* and *forgetting* are difficult words to define because of the obscurity of the states or processes to which they refer. However, the following definitions may prove helpful in assuring that we all mean the same thing when we use the terms. "REMEMBERING" IS THE RETENTION OF THE MODIFICATION IN BEHAVIOR ACCOMPLISHED IN LEARNING. "FORGETTING" IS THE DISAPPEARANCE OF THE EFFECTS OF LEARNING. As forgetting increases, remembering decreases; they are two aspects of the same process. We will examine them together since they seem to be inseparable.

Notice that, here again, we have defined two widely used words in terms of behavior—what the individual *does*. YOU CAN MAKE NO JUDGMENT OR COME TO ANY CONCLUSION REGARDING WHAT AN INDIVIDUAL HAS REMEMBERED OR FORGOTTEN UNLESS THE INDIVIDUAL SAYS OR DOES SOMETHING. This is an important principle that has immediate application to your own study situation, because, as we frequently noted in the preceding chapter, conclusions not based upon some sample of behavior are not trustworthy. The best way for you to as-

certain whether you have forgotten something or to determine how much of it you remember is to make one of the checks we have already discussed. Unless you do base your judgment on such concrete evidence, you will often find yourself unable to remember something that you thought you knew "as well as I know my own name."

As a test of this principle, you might try this little exercise: Most of us would claim that we could recite the names of all of the forty-eight states. We were all of us able to do it at one time during our education. How many of them could you name now? Could you name all of them? Could you remember forty-five? Notice that you would not take some other person's answer to that question. You would, instead, require him to name as many states as he could. Suppose you try it yourself; try writing them on a slip of paper, but *first* write down the number of states you are sure you can remember. It is a fairly safe gamble that you will surprise yourself. You may remember all of them, having thought you would do well to remember forty-five. Or, you may remember only forty-two or -three, having said before you started that you knew them all.

All of this discussion regarding the basis for our estimates of remembering and forgetting would be unnecessary but for the fact that a very widely accepted view of remembering seems to assume that, once a thing is learned, it is somehow or other "tucked into my memory" or "sticks in my mind." This very popular view considers learning, remembering, and forgetting as something separate from the behavior of the individual. Although such a point of view supplies ready answers to some puzzling questions, we know that such answers do not stand up under the test of experience. Its chief drawback, however, is that it tends to put these important aspects of behavior beyond the reach of scientific investigation.

Measures of Retention

We may now ask the same question about forgetting that we asked about learning. How do we measure forgetting? How do we demonstrate that it has taken place and to what extent

it has developed? There are four ways of showing how much forgetting has taken place: (1) THE METHOD OF REPRODUCTION, OR UNAIDED RECALL; (2) THE METHOD OF AIDED RECALL; (3) THE METHOD OF RECOGNITION; AND (4) THE SAVINGS, OR RELEARNING, METHOD.

1. *The method of reproduction, or unaided recall.* This method is simply a repetition of one of the practices of the original learning series—that is, the individual is required to do the same things he did during the original learning. He is given no help or prompting, but simply told to repeat something that at one time he had learned to do. The exercise that required you to write down the names of the forty-eight states is a good example of the measurement of retention by this method. In college, the so-called "essay" type of examination is also a use of the reproduction method. The amount of retention is measured by exactly the same devices with which learning was demonstrated. As a matter of fact, the method gives us a very useful picture of retention, because it does enable a direct comparison between the recall situation and the learning situation. If we used time as our measure of learning, we can also use time as our measure of forgetting.

2. *The method of aided recall.* This is just what the name implies. Some assistance is given the individual in the form of prompting of one kind or another. Those examinations that require you only to fill in a missing word or phrase, or to pair off definitions with the words they define are examples of the aided recall method. The measure used with this method is usually a simple count of the number of correct completions. Of course, unless this measure is applied immediately after learning, and then again at a later time, we have no basis for a judgment as to the amount forgotten in the interval. If, for instance, you should be asked to complete such a statement as: "The chief export of Brazil is . . . ," and were unable to fill in the missing word, we should have no way of knowing whether you had forgotten that bit of information unless it could be demonstrated that you could have answered that item correctly at some previous time. This method of measuring retention has the advantage that it usually shows the individual

to have remembered more than the method of reproduction will indicate. To use the above illustration again, it is conceivable that, in listing the exports of the various countries in South America, you might have completely neglected Brazil. The appearance of the above item in the examination would at least ensure that you did not forget Brazil, although you still might not remember what the chief export is.

3. *The method of recognition.* In the use of this method, the individual is required only to distinguish between material that he has previously learned and that which he has not learned. Various ways of designating this distinction are used, the most frequent one being the familiar *true-false examination.* This method is the easiest of all from the standpoint of the person being tested, because all he has to do is to indicate, in a very superficial fashion, that he has had some previous acquaintance with the content of an item. It is not necessary for him either to give his reason for the choice he makes or to complete his answer in any other way. Chance also enters into the performance in this type of test. The measurement used here is again simply number correct or some variation that will penalize for too much guessing. Of the three methods mentioned thus far, this method will show more remembered than either of the other two. In order to show the progress of forgetting, it also must be administered immediately after learning, as well as at a later time.

4. *The relearning, or savings, method.* This method is not usually employed in everyday situations. As the name implies, it measures retention in terms of the difference in the amount of time for the original learning, as compared with the amount of time for relearning to the same level of efficiency. It would be highly impracticable to employ such a method in course examinations. There are occasions, however, when it is useful. One characteristic of this method is that it is the most sensitive of all those we have been discussing. It will show some retention when all other methods fail. An individual may learn something, for instance, and be unable to reproduce it at a later time. This means that, if we used the method of reproduction as our measure of re-

tention, we must conclude that the material or performance has been completely forgotten. It is possible that, even with promptings, the individual would be unable to show any retention. It is further conceivable that he might not be able to recognize it when presented with other material that he had not learned. It would be very unusual, however, if this individual required the same amount of time to relearn the material or performance that he required for the original learning. This decrease in the amount of time for relearning would indicate that something from the previous learning had carried over during the intervening time. Just what this effect is in terms of neural processes no one seems to be able to say, but that it exists there is no doubt.

These, then, are the most widely used methods of measuring retention or demonstrating the amount of forgetting that has taken place. Notice that they all require the subject to do something, usually something quite specific. IF THE SUBJECT IS UNABLE TO FULFILL THE REQUIREMENT MADE BY THE PARTICULAR TEST OF RETENTION WE HAPPEN TO BE USING, WE CONCLUDE THAT HE HAS FORGOTTEN IT OR THAT HE NEVER REALLY LEARNED IT IN THE FIRST PLACE. This may seem to be a rather arbitrary and harsh judgment. Perhaps it is harsh; it certainly is arbitrary. But it is arbitrary only in the sense that every recall situation makes its own particular demands upon the individual. If he is unable to meet these demands, he must be judged inadequate as far as that situation is concerned. To make this point a little clearer, you may remember instances when your retention has been judged as zero, even though something was "right on the tip of my tongue," or "I knew it as well as I know my own name but couldn't think of it." If the recall situation requires that you reproduce a specific bit of information or perform some skillful act, you will, of course, receive zero for both of the above answers, even though you may remember them at a later time. As far as the present test of retention is concerned, you have forgotten; you cannot demonstrate that you remember. You will find that, not only college examinations and professors

make these demands, but many after-college situations are equally severe in requiring that you produce at a certain time and under certain conditions. When your employer asks: "Who are our five best customers?" or the question arises as to which formula the baby must have, it will do you very little good to have the answer only "on the tip of your tongue."

TABLE XVII

THE PER CENT RETAINED FOR NONSENSE SYLLABLES AND POETRY (from Ebbinghaus and Radosavljevich)

Period after Learning	EBBINGHAUS	RADOSAVLJEVICH	
	Nonsense Syllables	*Nonsense Syllables*	*Poetry*
5 minutes	..	98	100
20 minutes	59	89	96
1 hour	44	71	78
8 hours	36	47	58
24 hours	34	68	79
2 days	28	61	67
6 days	25	49	42
14 days	..	41	30
21 days	..	37	48
30 days	21	20	24

Factors Determining the Amount Remembered

Before we proceed to consider the factors that determine the rate at which forgetting takes place, we should note that we have already discussed some of them in considerable detail. These factors were discussed in the preceding chapter. EVERY FACTOR THAT DETERMINES THE RATE, EFFICIENCY, OR LEVEL OF LEARNING ALSO GOVERNS THE RATE AT WHICH FORGETTING TAKES PLACE. When, in the previous chapter, we have spoken of such a procedure as overlearning as being desirable, we have always based our judgment upon the fact that it tends to decrease the rate of forgetting and to increase retention. This

applies to overlearning, motivation, method of learning, severity of the criterion, and all the others.

Curves of forgetting

When Ebbinghaus introduced the nonsense syllables as material for learning, one of his outstanding contributions was the fact that, when a series of syllables had been learned to a

TABLE XVIII

THE EFFECT OF OVERLEARNING

Interval in Days	*Degree of Material Learned*	*Average Number of Words Recalled*	*Average Per Cent of Words Recalled*	*Average Per Cent of Score*
1	100	3.10	25.83	21.73%
	150	4.60	38.33	36.15
	200	5.83	48.58	47.10
2	100	1.80	15.00	13.40
	150	3.60	30.00	33.45
	200	4.65	38.75	42.05
4	100	0.50	4.17	3.40
	150	2.05	17.08	29.75
	200	3.30	27.50	32.30
7	100	0.20	1.67	1.75
	150	1.30	10.83	23.15
	200	1.65	13.75	27.55
14	100	0.15	1.25	1.65
	150	0.65	5.42	20.80
	200	0.90	7.50	23.45
28	100	0.00	0.00	1.50
	150	0.25	2.08	20.50
	200	0.40	3.33	25.10

point where they could be recited once correctly, the amount forgotten was relatively greater immediately following the learning than it was at a later period. His loss was forty-one per cent in the first twenty minutes, but only sixty per cent in the first hour.

Other investigators have since obtained similar results when the material was learned to a point of one correct repetition, but where the material was overlearned—that is, when it could

be recited correctly two or more times—the curve of forgetting falls more gradually. Table XVII gives the results of Ebbinghaus and an investigator who required two repetitions. The curves for these data shown in Figure 75 give a better picture of the curve of forgetting over the period studied. In both of these studies, we could say that the learning has progressed to the threshold. A great deal of student learning is of this sort. He studies most of his subjects with a view to passing the course or just "getting by" for the time being. Under these circumstances, it is to be expected that he will forget rapidly. The effect of learning to the threshold, or the

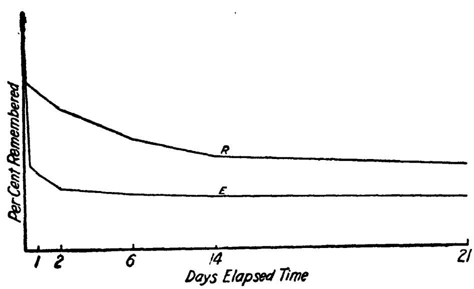

Figure 75.

point at which one correct recitation is possible, as compared with overlearning is illustrated in an experiment in which series of twelve one-syllable words were learned by the *anticipation method.* The words were exposed at a regular rate, and the subject read the words through the first time. Then, on the second exposure, as one word appeared, he attempted to anticipate the next word before it appeared. This threshold of learning was made the basis of comparison, and was designated 100. In another series, when this point was reached, he was given half as many more recitations. This was therefore designated 150, on the basis of the number of repetitions necessary for a single recitation, and a third series was designated 200 on the basis of the first learning. If you construct three curves on the basis of the data supplied in Table XVIII, representing the series repeated to the threshold of learning 100, 150, and 200,

you will find that the curve for 100 falls much more rapidly than the curve for 200.

Many things that we have learned we seem never to forget. For example, if you learned to skate when you were twelve years old and had no opportunity to skate since then, you would probably find little difficulty in skating as well as you did in your early boyhood. The point is that you learned to skate more thoroughly than you learned your history lesson at that time. Another item in our great memory for some events is that we have repeated them at invervals. Some insignificant statement that we heard in childhood we remember today, but we have also recalled it many times in the interim.

Conditions of Recall

Similarity between learning and recall situations

THE AMOUNT REMEMBERED WILL BE DETERMINED, IN PART, BY THE RELATIONSHIP BETWEEN THE CONDITIONS OF LEARNING AND THE CONDITIONS OF RECALL. THE GREATER THE IDENTITY BETWEEN THESE SITUATIONS, THE GREATER WILL BE THE RETENTION. THIS IS A GOOD PRINCIPLE FOR YOU TO REMEMBER IN STUDYING FOR CERTAIN COURSES. If you put it into practice, it will mean that some part of your study time should be spent in doing the very things that will be required of you when the examination is given. The examination will be less disturbing if, when you study for an examination, you include the examination situation in your learning. Ask yourself questions; give yourself problems to solve, new passages to translate, words and formulas to remember. In other words, if all you do in preparing for a test of recall is to read, you have engaged in very little practice of those acts upon which you will be graded. This relationship between the conditions of learning and the conditions of recall is often more subtle than we might suspect. It refers also to the environmental conditions, such as the room in which you do your studying, and even your posture. This means that you would do well to do some of your studying at the time and in the place where you will do your reciting or take your examination. A great deal of what

is popularly known as "examination fright" can be done away with by incorporating the examination situation into the original learning conditions.

We have suggested that sometimes an answer will not appear immediately after a question is asked, but that the material may be remembered at a later time. When this happens, we can usually trace it to the particular wording of the question. Always remember that questions are usually phrased so that they will be understood by a number of people, or they are phrased in terms of the professor's understanding of the subject matter. One reason that you may have difficulty in recalling certain answers in response to certain questions is that you have learned your material under too highly specialized conditions; you can recall it only if you are questioned about it in a certain way. Of course, the way to prevent this from occurring is to learn your material as answers to as many different kinds of questions as it is possible for you to construct. This means simply that, IF THE CONDITIONS OF RECALL ARE UNKNOWN, RETENTION WILL BE ENHANCED IF THE LEARNING OCCURS UNDER AS MANY DIFFERENT CONDITIONS AS POSSIBLE.

Amount and kind of intervening activity

That forgetting is in part, at least, due to the activities that follow learning is illustrated by experiments [1] in which the subjects sometimes remained at as nearly complete rest as possible until time for the test to be given. Imagine that you are confronted with a chessboard, screened from view, on which the experimenter places in any arrangement a pawn, a bishop, a castle, and a king and queen. The screen is then removed for fifteen seconds, and you are supposed to memorize the position of the five pieces. Then, you remain quiet for fifteen minutes. The test is to replace the pieces in the positions in which you had originally observed. At another period, you do the same thing except that, in the interval between learning and testing, you are required to multiply or add figures. The investigation also involved learning nonsense syllables, with

[1] Skaggs, E. B., *Further Studies in Retroactive Inhibition,* Psychology Monographs, No. 161 (1925), Vol. XXXIV.

various activities intervening between the learning and the time retention was measured.

In these experiments, the subjects' scores were higher after rest periods than after work. The inference was that retroactive inhibition was responsible for the loss following the work periods. This means that the work that followed interfered with what had been learned. However, the response of the subjects indicated that, even though they did not intend to think about the set-up of the chess pieces or repeat the nonsense syllables, they often caught themselves doing so. It may therefore be that, in one case, the advantage was due to partial repetition during the "quiet" periods; and the disadvantage was due to the fact that the work itself prevented even a partial rehearsal of the material. You probably have frequently found that, after studying assiduously in one subject, the words and many of the items come to you as you are walking down the street or when you are sitting quietly in your room. This bobbing up of learned material is a great advantage, but you cannot expect it to occur if you are talking about your latest movie favorite. In order for it to happen, the cues in the recall situation must bear some relationship to the conditions of learning.

Perhaps the most effective way of establishing a passive period is to allow the subject to sleep. We would not expect the subject to repeat or practice the material in this condition. Two subjects [2] were allowed to sleep one, two, four, or eight hours immediately after learning nonsense syllables. The results of these periods were then compared with the results of equal waking periods. Figure 76 shows that the loss was considerably greater for both subjects following routine work. Their curves resemble more nearly the traditional forgetting curves. When the interval was employed in sleep, the curves remained horizontal after two hours. A slight difference for one and two hours may be attributed to a delay in actually going to sleep.

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[2] Jenkins, J. G., and Dallenbach, K. M., "Oblivescence during Sleep and Waking," in *American Journal of Psychology* (1924), Vol. XXXV, pp. 605–612.

In another experiment,[3] three subjects learned lists of nonsense syllables, either at bedtime or two or three hours earlier. In each case, they were tested twenty-four hours after learning. Thus, the usual period of sleep was included in all experiments; but in one case, the subjects learned and immediately went to sleep. In all three cases, it was found (Table XIX) that when they went to sleep immediately after learning, their scores were higher than they were after they sat up two or three hours. This may be significant in showing that complete inactivity renders the consolidation process following the learning activity more effective, because the greatest rate of forgetting is in the period immediately following learning. This would also be the period of greatest value of the perseverative activity that we have called *consolidation*. Practically, it means that the student who studies for his examination and goes to bed immediately will be in a better position to succeed the next day than he will if he studies earlier in the evening and then plays bridge until bedtime.

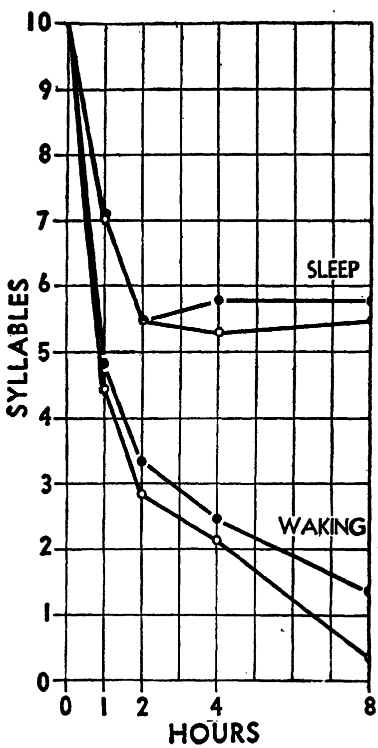

Figure 76.—Curves Showing the Loss of Learning During Sleep and Waking States for Two Subjects. (*Jenkins and Dallenbach.*)

The relationship between the kind of intervening activity and retention is not so clear-cut as it is with the amount of activity. In general, we may say that the more nearly similar

[3] Heine, Rosa, "Ueber Wiedererkennen und rückwirkende Hemmung," in *Zeitschrift für Psychologie und Physiologie der Sinnesorgane* (1914), Vol. LXVIII, pp. 161–236.

the intervening activity, the greater will be the interference with previous learning. If learning one list of nonsense syllables is followed by learning other lists of nonsense syllables, less retention of the first list will be shown than if the intervening period were employed in reading a magazine. If learning a poem or prose selection is followed by learning other similar selections, retention for the first will be less than if the interval is taken up by playing basketball. Applied to your study, this means that you will do well to avoid studying certain subjects immediately after you have studied others. Just which courses interfere most with each other you must de-

TABLE XIX

RELATION OF RETENTION TO THE TIME OF LEARNING BEFORE SLEEP
(Retention tested after 24 hours)

Subject	*Per Cent Learned Early*	*Per Cent Learned at Bedtime*
L	34	44
C	36	49
W	35	42
Average	35	45

termine for yourself from experience. Of course, some sequences of study sessions follow each other rather nicely, because the material learned in one applies directly to the following subject. You might, for instance, study your physics immediately after you had completed your trigonometry assignment. When the effect of your previous learning is of this nature, you will note that the two situations contain a number of identical—not similar—elements.

Reminiscence

Often, we find that, after spending some time in an attempt to learn material, we are able to reproduce more of it at a later date than we were immediately after learning it. This improvement in ability to recall has been termed *reminiscence.* Thus far, our discussion of learning has emphasized the learning by rote, or verbatim learning. It is important that we

learn many things in this way. For example, vocabulary is very important when we are attacking a new subject and many facts have to be learned with exactness, even though we forget them rather readily. It is because we have learned these facts that we are able to evolve principles or generalizations in the field of study. A principle expresses a fundamental uniformity that we discover in the facts we learn. These principles are remembered longer, and may even be extended without any evident practice.

We have previously cited the example of a final examination's being given a week later to the same group of students

TABLE XX

Memory for Objects with the Lapse of Time

Test	*Time of Testing*	*Number of Objects Remembered*
1	Immediately	5.4
2	After ½ hour	5.1
3	After 1 hour	6.3
4	After 5 hours	7.0
5	After 24 hours	7.8
6	After 4 days	7.6
7	After 4 weeks	7.4

as they entered the second term. This examination was almost wholly made up of items of fact—such as the definition of terms and statement of specific data—that had been learned in the first course. In contrast with this experiment, a similar one was given to juniors and seniors who had taken the first course in the freshman year. In this case, the items were more distinctly a statement of principles. It was found that the group as a whole obtained a higher score on the second examination, even though the students had not been registered in a similar course for approximately two years. This improvement may be due to the increased maturity of the students and to the integration of the first principles in a generalized body of knowledge.

In one experiment with school children twelve to thirteen

years old,[4] a number of toys were placed in a box and then exposed for a brief period. When these children were tested immediately after the exposure, they could name, on the average, 5.4 objects; but when tested at later periods, they remembered more than on the original test, as shown in Table XX. This increase in recall was considered as being due to reminiscence, or the organization that takes place after learning. However, it may have been due to two factors: (1) they may have thought about the experiment during the interval because it was of some interest to them; and (2) each test in itself was a partial repetition.

TABLE XXI

RECALL ON TWO SUCCESSIVE TESTS OF A WORD LIST AND NAMING THE STATES

Test	*Word List*	*Naming of States*
Test 1:		
Number of words recalled	25.48	36.41
Test 2:		
Number of words repeated	22.44	34.37
Number of new words	4.33	5.29
Total score	26.77	39.66

This second possibility[5] is shown in another experiment in which students were read a list of forty-eight words. After the immediate recall test, a half-hour lecture was given; and then, without previous warning, a second recall test was introduced. In another college group, without previous warning, the students were asked to write the names of the forty-eight states; and again, after a half-hour lecture, they repeated the test. The results are given in Table XXI. It will be seen that, in both cases, the score was higher for the second than for the first test. However, in both cases, they recalled fewer of the words in the second test than they had recalled in the

[4] Nicolai, F., "Experimentelle Untersunchungen über das Haften von Gesichtseindrücken und dessen zeitlichen Verlauf," in *Archiv für die Gesamte Psychologie* (1922), Vol. XLII, pp. 132–149.

[5] Brown, W., "To What Extent Is Memory Measured by a Single Recall?" in *Journal of Experimental Psychology* (1936), Vol. VI, pp. 377–382.

first, but enough additional words to increase the score. In the word list, we might assume that remembering continued after the words had been read to the subjects; but this could not have been true in naming the states, for, presumably, they had learned these names years before. They were given no opportunity for repeating and studying the words during the lecture, so that this possibility seems to be ruled out. Possibly, the practice on the first test would influence some of the recall on the later test, and the variations due to different postures on the two tests may have accounted for improvement.

The nature of this improvement after an interval is made clearer by an experiment made with college students [6] who were tested with psychological material in a course in psychology. Especially prepared articles on psychology were read twice by the students, who were then divided into two groups. One group was given a true-false test of eighteen items that were verbatim reproductions of the test material, except for slight revisions that were necessary to make part of the items false. The other group was given a similar test, except that the statements were reworded to give the content in a different form. These tests were given ten minutes after the original reading, and again twenty-four hours, fourteen days, and thirty days later. The groups that were given the verbatim tests secured a lower score as the interval was increased to fourteen and thirty days. On the other hand, those who were given the paraphrased items increased fairly constantly throughout the period. Two possible explanations might be given:

1. With repetition of the test, a certain amount of learning took place as a result of the repetition of the test material. If this were true, it should have worked with the verbatim items as well as with the paraphrased items. Furthermore, in another experiment, these same groups were only given the test after ten minutes and again after fifty-five days, and a similar group was given the paraphrased items. Here, again, the results were very similar.

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[6] English, H. B., Welborn, E. L., and Killian, C. D., "Studies in Substance Learning," in *Journal of Genetic Psychology* (1934), Vol. XI, pp. 233–260.

2. A second explanation is that these students were learning more psychology in the intervals than they were in psychology class. It is possible that this had its effect in the paraphrased test but that the passage of time made possible the remembering of the general facts or principles, and at the same time the learning of the verbatim or exact statements had deteriorated.

The second feature of these experiments in reminiscence is that, while we do forget detailed items, we are able to remember the general principles we have evolved in our study. Also, the closer contact we have with the material, even though we are studying it intensely, the more permanent it becomes in our memory. We are more likely to recall in whole or in part a poem that was interesting or subjects we have enjoyed studying, and thereby render them more permanent. The exciting events of the evening may be recalled several times during the next day. The routine work that has not been thought about again is forgotten. Therefore, the student who is interested in his work and talks about the subject matter, who lives with students who are inclined to discuss their studies, gains without any observable effort a great deal that would require considerable investment of time and energy to learn otherwise.

Emotional tone

It is often remarked that we learn more easily the things we enjoy, or that we forget the unpleasant more readily than the pleasant. This has lead, in the past, to the assumption that pleasantness is the basis of learning or the cause for learning. You will recall that, in the earlier chapter dealing with feeling, it was pointed out that there is a close relationship between what we call *motive* and what we call *pleasure, interest,* and *desire.* We probably forget more of the unfortunate experiences than we do of the pleasant because we are constantly making adjustments, and those experiences that were disagreeable we eliminated by an attempt to do better in similar situations at a later time. We also like to dwell upon the pleasant events of the past, rather than upon those events that were unpleasant.

One experimenter [7] asked a class of college students to write all the pleasant experiences of the past three weeks that could be recalled in seven minutes. The students were then requested to list all the unpleasant experiences for the same period. At a later time, they were asked to recall the same experiences of the same three-week period. In the first recall, they listed an average of 16.35 pleasant experiences and 13.7 unpleasant experiences. Three weeks later, they listed an average of 7 of these pleasant experiences and 3.86 of the unpleasant. This means that they listed at the second test an average of 42.80

TABLE XXII

MEMORY FOR PLEASANT VERSUS UNPLEASANT EXAMINATION MARKS

Reaction to Scores	*No Record Kept*	*Record Kept*
Very pleasant	52%	65%
Pleasant	41	37
Indifferent	31	34
Unpleasant	32	38
Very unpleasant	32	43

per cent of the original pleasant experiences and 28.18 per cent of the unpleasant experiences.

In another investigation with seventy-six college students,[8] all women, ten true-false examinations were scored and returned to the class. Each student rated her own reaction to her score as each test was received. Five weeks later, they were asked to recall all ten examination scores. Some of the subjects had kept written records of the scores, which indicated a greater interest and may account for the greater recall of the very unpleasant. Table XXII gives the results. It will be seen that those who kept no written record remembered more of the scores that gave them pleasure than of those they considered very unpleasant. The same is true for those who kept

[7] Jersild, A. T., "Memory for the Pleasant as Compared with Memory for the Unpleasant," in *Journal of Experimental Psychology* (1931), Vol. XIV, pp. 284–288.

[8] Koch, H. L., "The Influence of Some Affective Factors upon Recall," in *Journal of Genetic Psychology* (1930), Vol. IV, pp. 171–189.

a record, except that the very unpleasant scores were remembered more frequently than in the other group.

Elimination of Undesirable Habits

Sometimes, instead of allowing forgetting to follow its natural course, we may be required to accelerate it somewhat. The ways in which we do this may throw some light on the nature of forgetting. Although the adult is constantly learning new material and new patterns of response, he is continuously beset with the necessity of "unlearning" or avoiding responses that he had learned at an earlier date and that are now undesirable. The young man who comes to the city from the country, or the Easterner who goes to the Middle West, has the marks of his early environment stamped upon him. The European coming to America likewise brings numerous traits that may be undesirable in the new situation. Nail biting, scratching the head, walking while speaking, and numerous other habits may be formed that at some time prove to be a disadvantage to the victim.

Numerous methods have been suggested and tried for dealing with these undesirable habits: [9]

1. One method is *to find the cues or stimuli that initiate the action and practice another response to these cues.* This leaves the old habit, but steps up new modes of response that sidetrack the old habit so that it can be avoided. Thus, the country boy may learn to behave and speak like the city boy because he has observed the specific situation in which his country manners are initiated and has learned the acceptable modes of response. When he returns to the farm, he may take on the manners of the farmer. A smoker may decide that, for the sake of his health, he ought to stop smoking. What he might do in this situation is to make a list of all the situations in which he is inclined to reach for a cigarette. He may find that waiting, emotional disturbances, perplexity, doing certain kinds of activities, and numerous other situations are the

[9] Guthrie, E. R., *The Psychology of Learning* (New York: Harper and Brothers, 1935), Ch. XI.

stimuli. He may then practice reaching for a stick of gum whenever he is perplexed, or when he has to wait for an associate, or is about to write a letter.

2. Another method is the *exhaustion method.* The Western cowboy uses this method to break a horse to the saddle. The horse is tied and the bridle put on; then the man mounts and attempts to "stick with him." If he succeeds, the horse bucks until he is exhausted. This method is reported to have been used with a child who persisted in lighting matches. One day his mother took him into the backyard and gave him boxes of matches, instructing him to strike one match after another, which was kept up until the child was utterly sick of the activity. The mother had no further difficulties with matches being struck about the house.

3. A third method, which is closely related to the exhaustion method, is *negative practice,* or *practice in the behavior that one wishes to avoid.* A psychologist[10] was disturbed by the fact that, in typing, he frequently wrote *hte* for *the.* He finally typed *hte* until he had filled a page and a half, single space. Every time he wrote it, he said: "This is wrong." He reported that, thereafter, he never had any difficulty in writing *the* correctly. From time to time, a student who has some disagreeable habit has tried using this method, with success. The application of this method to a case of daydreaming that was interfering with a student's work was cited in a previous chapter (page 151). Another student scratched his head while studying until his scalp was sore. He likewise spent a definite period every day in doing nothing but head scratching, and succeeded in breaking himself of the habit. The explanation of this seems to be that such habits as writing *hte* have no place in the needs of the individual; and when they are practiced, they become specific skills that could be used if necessary, but no need arises. The truth of this explanation becomes evident when you consider numerous other skills. If you are only moderately skilled in two foreign languages—say, French and German—you will find yourself using French words

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[10] Dunlap, K., *Habits, Their Making and Unmaking* (New York: Liveright, Incorporated, 1932), pp. 326.

when you attempt to speak German, and vice versa. One who is proficient in both languages will rarely do that.

4. A fourth method is the *toleration method.* For example, if one wishes to break the cigarette habit, he may gradually reduce the number of cigarettes that he allows himself until he has finally quit entirely. This seems the most painless method and the most usual method that is adopted, but it is perhaps the least likely to succeed. In any case, the bad habit must be undesirable to the subject. Many people say that they would like to stop smoking, but the reason they do not is probably that they can find no particularly strong motive for stopping. If they were convinced that their life depended upon it, they would probably be able to use any method and succeed.

Summary

With all the evidence of the two preceding chapters before us, we may conclude that forgetting is not merely the simple fading out process that it is popularly believed to be. What we have learned not only fades, but is also destroyed by other activities. If we wish to remember, therefore, the best we can do is to avoid those activities that are most remote from the activities involved in the material learned. This suggests another aid to remembering. Keep in close contact with the material that you desire to remember. In other words, relate your college subjects. Psychology is closely related to the biological sciences; on the other hand, it is just as closely related to literature and history. Don't compartmentalize the subject matter of your courses.

How well you can remember what you have learned depends upon how well you have learned it in the first place. Forgetting begins immediately after learning ceases. If you wish to remember for a long time, the material must be overlearned. But this is not the only criterion of your ability to recall at a later date. The situation in which the material is to be used must be learned with the material. Therefore, learn the material with a view of using it later, in as many situations as possible—in the classroom, in your chosen profession, in daily

life. You should be able to write a good paper in history or physics as well as in an English course.

Review the preceding two chapters, and list what you consider good rules to follow in making your learning and remembering most effective.

15

Thinking

Learning and Reasoning

We have asserted that the chief task of the student is to learn facts and principles. The student often objects to this limitation, because he conceives of an education as learning how to think. He generally prefers a discussion section to a lecture section, because he believes that, by being allowed to express his views, he is learning to think. There is a good deal of confusion of terms expressed in this supposition. We must recognize that there is a wide gap between expressing opinions in debate on the one hand and really solving problems and reasoning on the other. Debating is a skill in convincing others or oneself of a desired point of view, without special reference to analysis of the facts in the case. We come by our opinions usually through a process of assimilation from the arguments and opinions expressed in our group. Too often, the student maintains these opinions and, by a process of "logic," attempts to vindicate his beliefs.

Opposed to this method of class discussion is the method of inquiry in which a student states his opinion or belief, which is then evaluated—by himself, by other students, or by the instructor—on a basis of facts and principles already established. The opinion is then discarded or accepted in terms of the extent to which it satisfies the requirements of the problem for which it was offered as a solution. The important difference is that, in this latter method, the student notes the application of each principle to the proposition that has been made.

The discussion method of conducting a course may degenerate from a learning situation to a recitation class in which a student merely recites what he has learned, without any attempt to organize the material or apply it to practical situations. Students also differ in their attitude toward the material of a course. Many students excel in learning the facts and principles as they are presented, and can repeat these facts at a later period with a high degree of accuracy. A few students, however, may learn the facts and also organize them in such a manner that they can be used whenever a problem arises in which these facts are applicable.

We might add a third group who refuse to learn facts but assume that they can "reason" to a proper conclusion. It is characteristic of many individuals—in fact, of all of us at times—to avoid the solution of problems, even though we pride ourselves on our superiority over lower animals on the ground that we can think, while lower animals are devoid of this ability. When we meet a problem situation, we may become emotional or may disregard the problem; or we take some other line of action, thus evading the situation entirely.

What is REASONING? "THINKING," OR "REASONING," IS THE NAME APPLIED TO THE BEHAVIOR WHICH ATTEMPTS TO SOLVE A PROBLEM SITUATION. Again, you will notice that we are applying the term *reasoning* to an aspect of behavior. As a matter of fact, we never say that an individual is "reasoning" unless he does or says something. Sometimes his behavior is rather obvious. The individual will frown, or scratch his head, or stare into space. As we shall see, this particular behavior is not usually admitted to be reasoning. More legitimately, it may be said to "accompany reasoning." But now and then, we may actually see or hear the reasoning process itself. Presented with a problem, the individual may begin to mumble; in another situation, his hands or body may go through "half-movements." These external evidences are enough to convince us that something is going on "inside." It is enough to show us that implicit behavior constitutes a greater part of reasoning than does explicit behavior.

It may be a little hard for you to realize the importance of the role of implicit behavior in learning. The chances are

very good that you never heard of implicit behavior until you read this book. Not only that—most of us have had rather definite notions regarding what thinking is or what it is done by. It may be a little hard for you to reorganize your own thinking in the matter. It will be more helpful for us to talk of thinking in terms of behavior than to adhere to popular beliefs concerning its nature. Grandmother has told us to "put your thinking caps on" when some problem arose; father refuses to help his son with his arithmetic homework because "my mind is too tired"; John will never make a success as a lawyer because he has no "faculty for thinking things out." "Thinking cap," "mind," "faculty" again are names. They do not describe or explain anything. In a scientific description of behavior, we had best avoid them.

Steps in the reasoning process

We can usually identify four steps in the reasoning process:

1. By definition, a problem must *occur*—that is to say, there is no reasoning unless there is a problem. It is not always easy to isolate or identify the problem, but we have stated that *reasoning is a response to a problem situation.* The details of the problem will, of course, vary enormously from problem to problem. Some general characteristics, however, will be fairly constant. A problem situation usually interferes with the normal, smooth-running course of behavior. It may be only a virtual interference, such as the posing of a question; or it may be an actual interference, such as the restriction or confinement of bodily activity.

2. Once the problem is presented, the organism will behave in the manner in which it reacted to the most recent or most similar situation—that is, individual aspects of the problem will elicit the same responses that they have elicited on previous occasions, although in different situations. If these responses are unsuccessful in satisfying the demands of the problem, the organism will continue to behave in terms of its own repertoire of past experiences. The particular responses that will occur, the order in which they will occur, and their

duration or persistence are describable entirely in terms of the organism's past and whatever changes occur in the problem, if it should not remain constant.

3. The end of the trial-and-error period of step 2 will occur when a solution appears. A true solution satisfies the demands of the problem, or modifies the environment in such a way that the problem ceases to exist. False solutions or pseudosolutions may also appear. These solutions satisfy the individual, so that he may cease responding to the problem; but they do not satisfy the demands of the problem. That is, the problem continues to exist. Many problems are of such a nature that the interference with behavior is not serious or gross enough to require a true solution. Under these conditions, a pseudosolution may be enough to bring the trial-and-error period to an end.

4. Perhaps not an integral part of the reasoning process, but certainly a natural result in many instances, is the disorganization that develops when a solution does not appear. Emotion is also the response of the organism to a situation for which it has no adaptive behavior. An unsolved problem becomes such a situation, and an emotion is the natural consequence if the problem is such that the behavior of the organism is grossly interfered with.

Trial and error in reasoning

It will be seen from the above description of the reasoning process that what we call *trial and error* is an important part of the whole process. This does not mean a blind trial of one thing after another; but at each step, we set up an hypothesis and try it out. If it fails, it is an error, and something else is suggested as an alternative.

This is very similar to what we find in the classic experiments of maze learning: A rat is placed in a maze, such as that shown in Figure 77. A hungry rat may be placed at *A*, the starting point. When he gets to *B*, he will be fed. Never having been in this maze before, when the rat reaches a turning point, he may turn either right or left. Suppose the rat turns to the right. Something in the animal's make-up produced this

choice. It may have been that the animal had previously been trained in mazes in which right turns were rewarded more frequently than left turns. Or, it may be that a variety of past experiences and structural differences made turning right at this time more potent than turning left. It is a "trial" performance, and therefore a hypothesis. When he reaches the end of the blind alley, he must retrace. This process is con-

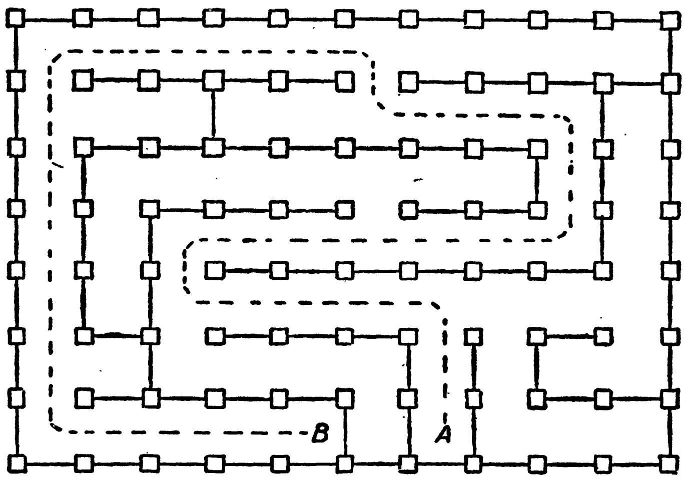

FIGURE 77.—ONE FORM OF MAZE. *A* is the starting point and *B* the food box. The line indicates the correct path. (*Modified from the J. F. Shepard maze.*)

tinued until, finally, he ends at *B* and secures the food. We may say, therefore, that he has now "solved the problem." This does not mean that, on a second trial, he may be able to go directly to the food. If he continues running the maze, we say that is learning—because he makes fewer errors with each trial, until he is finally able to run the entire maze without error. This is illustrated by the learning curve represented in Figure 78.[1]

Into the period of trial-and-error behavior that follows the occurrence of the problem there is crammed so much, and its duration is frequently so short, that we fail entirely to identify

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[1] Ford, Adelbert, *Maze Learning in White Rats*, a movie film prepared at the University of Michigan.

any clearly differentiated steps or processes. This fact has made the experimental investigation of reasoning a very difficult task. Quantification of the behavior is next to impossible. Therefore, you will find less actual measurement in this chapter than has been the case in anything we have discussed so far. We shall turn to a number of experiments—most of which have been done with animals—and some everyday observations, in an attempt to point up some of the things that happen during

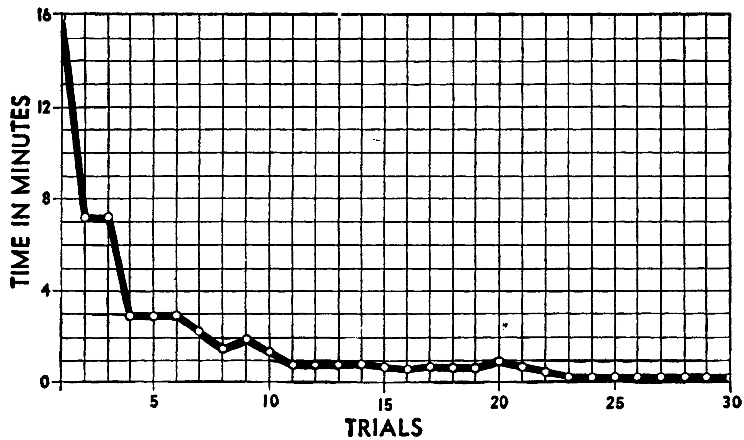

FIGURE 78.—A CURVE OF THE AVERAGE TIME OF 19 RATS IN LEARNING A MAZE. (*Watson.*)

thinking. We must realize that all of the things we shall discuss do not necessarily appear in *every* problem-solving situation. Perhaps, after we have examined some of the things which do happen, we can come to a somewhat more definite understanding of reasoning as a form of behavior.

A simple problem in reasoning of the sort with which we may be confronted any day is illustrated by the following account: An assistant in the laboratory desired to move a long table from one room to another. The arrangement of the rooms is illustrated in Figure 79. It will be seen that there are three rooms, the doors of which are in adjacent corners. The problem was to move the table, *T*, from room *A* to room *C*. Here are the steps by which the problem was finally solved:

1. When the assistant had dragged the table to the door

from *A* to *B,* he found that the table was too wide.

2. He then tipped it up on edge, so that the legs came against the side wall. Then, he found that the legs were too long and that the wall prevented turning the tables so as to slip the feet of the legs through first.

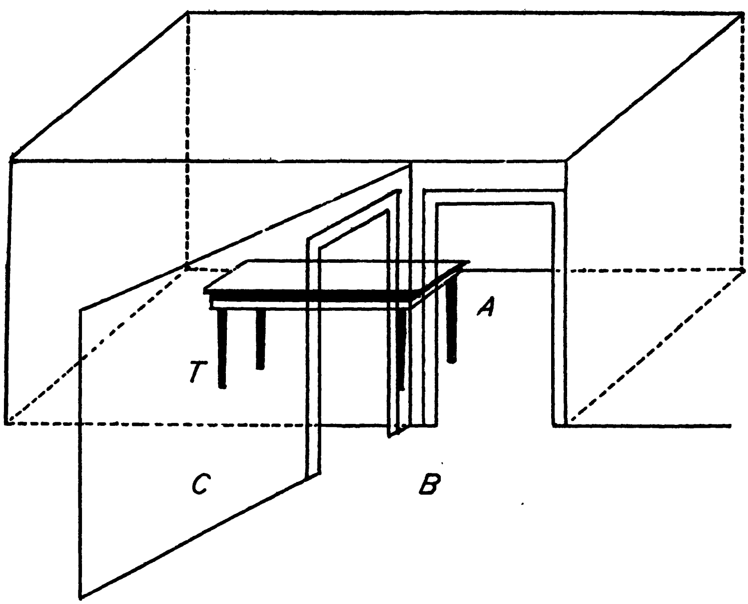

FIGURE 79.—THE PROBLEM OF MOVING A TABLE FROM ROOM A TO ROOM C.

3. He tipped the table over in the other direction, and was then able to slip the feet and legs of one end through the door of *A* to *B,* and also through the door leading to room *C.* This was another failure, because the table was so long that the front legs bumped against the wall, and the top of the table against the side of the two doors.

4. After pulling the table back to room *A,* he realized that the solution could be reached if the table were not so long. This suggested standing the table on end and swinging it around the wall into room *C.* This was the final solution of his problem.

The trial and error in this solution was plainly explicit, but couldn't the problem have been solved more easily if the in-

structor had "used his head"? He might have sized up the total situation—the length and breadth of the table; the width and height of the doors; the position of the walls; and, finally, the length of the table legs. When he had taken into account the relation of all these facts, he might have been able to move the table on a single trial. This is what the engineer must do. He cannot build a bridge by laying a beam to discover whether it is too long or too short. BOTH THE ASSISTANT AND THE ENGINEER WOULD BE "THINKING THROUGH" THE PROBLEM BY IMPLICIT TRIAL AND ERROR. VERBAL AND OTHER SYMBOLIC BEHAVIOR WOULD BE SUBSTITUTED FOR THE GROSS MOVEMENTS THE ASSISTANT ACTUALLY USED.

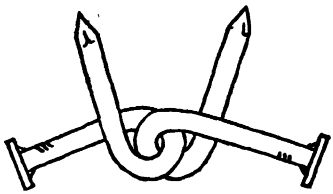

FIGURE 80.—THE BENT-NAIL PUZZLE.

Puzzles. There are a great variety of puzzles that we enjoy playing with which are illustrative of these points regarding problems in reasoning.

A simple puzzle of bent nails, illustrated in Figure 80, is a good example of one type. These nails can be taken apart very easily when one has discovered the moves to be made. When one attempts this for the first time, he exhibits the same trial-and-error movements that the rat would make in the maze. His trials are less deliberate than those of the assistant moving the table He usually twists the nails aimlessly first in one direction and then in another. He may twist them in such a way that they would come apart if it were not for the heads. If this does not give him the proper cue, when he finally has taken them apart, he very likely fails to recognize what the last move was; and his second trial may require as much time as the first.

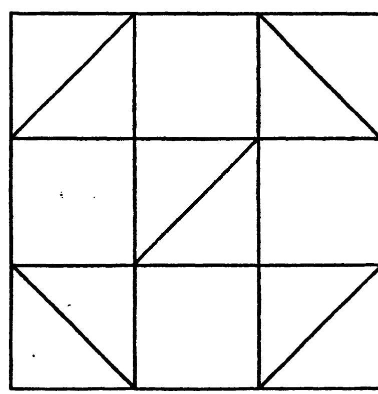

FIGURE 81.—A UNICURSAL PUZZLE.

In the unicursal puzzle shown in Figure 81, the task is to

trace all of the lines without repeating. The subject may again make aimless trials of the sort made with the nail puzzle, but he is more likely to discover a principle. This may be only a tentative lead that fails in the first attempt; but from then on, he is on his way to the proper solution.

Requirements for solving problems

An examination of the preceding examples will reveal that one of the important features in solving any problem is the ability to observe the total situation. A more adequate solution of moving the table from the standpoint of thinking would have been to observe the relative proportions of tables and doors, and the arrangement of the walls. If the assistant had done this, he could probably have moved the table on the first trial. This would not have been so easy with the nail puzzle, because there is so little to be observed. However, the time could have been shortened markedly by a careful examination of the relations of the parts.

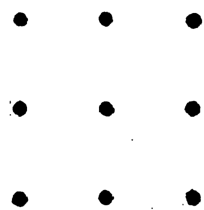

FIGURE 82.

ANALYSIS, THEREFORE, IS ANOTHER IMPORTANT ITEM IN THE REASONING PROCESS.

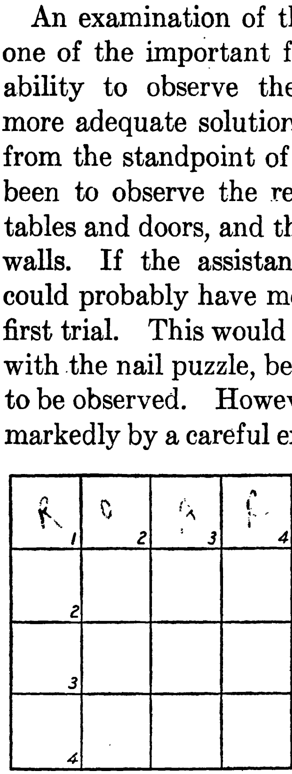

FIGURE 83.—CROSSWORD PUZZLE.

Directions:
Vertical
1. A species of insect
2. Organs of vision
3. To annoy
4. Comfort

Horizontal
1. What lions can do
2. What horses can do
3. What monkeys can do
4. What men can do

Still another important factor is the ability to vary the type of response. Often, our difficulty lies in the fact that we keep repeating the same reaction, even when we have found that it does not work. This is illustrated in the so-called "trick puzzles."

In Figure 82 are nine dots. The problem is to draw four straight lines, joined together, that will pass through the nine dots without retracing. If you attempt to do this, continue to ask yourself repeatedly what you are doing. You will not be able to solve this problem until you have discontinued one limitation that you have placed upon

yourself. The chances are that you are confining the limits to the area indicated by the dots. There is nothing in the directions to restrict you to this area. The fact that you repeat the same responses over and over is an indication of what is called the influence of *direction habits.*[2] With this concept of direction habits in mind, attempt to solve the crossword puzzle given in Figure 83.

Problem Solving in Relation to Difficulty

Solution of simple problems

Often in experimentation, the scope of the problem is beyond the subject's ability. Also, the subject often hits upon a solution that is correct but not the required one—that is, a problem may have more than one correct solution. In a current radio program, this question was asked of a person in the audience: "Where can you sit in this theater where I can't?" The answer given was "on the chandelier." The master of ceremonies admitted that the answer was probably true, although the answer he expected was "on your lap."

In an experiment with chimpanzees, a basket of fruit was hung by a rope from the top of a cage. The other end of the rope in the form of a loop was slipped over the stump of a limb of a tree. The chimpanzee first attempted to reach the fruit by jumping. Then, he climbed the tree and pulled vigorously on the rope, jerking the basket to the top of the cage and breaking the rope. Although the simpler method would have been to slip the loop off the stump, he continued to break the rope. It can be seen that, after a few futile attempts to reach the fruit by jumping, he perceived the relation of the rope to the basket but failed to discover the correct method expected by the experimenter.

In another experiment, fruit was placed outside the cage, out of arm's reach, and a stick with which the fruit would be

[2] Meier, Norman F., "An Aspect of Human Reasoning," in *British Journal of Psychology* (1933), Vol. XXIV, pp. 144–455.

raked in was provided. If the stick was placed between the ape and the fruit, or within easy reach, he had no difficulty in utilizing it. If, however, the stick was out of sight, behind him, he failed to make the connection between the fruit and the stick as a tool for reaching it. IN OTHER WORDS, HE WAS LIMITED TO WHAT LAY WITHIN THE FIELD OF VISION AT ANY ONE MOMENT.

With further experience, a stick—regardless of where it was placed—was quickly appropriated. On one occasion, when no stick was to be found, one ape suddenly left the side of the cage, ran into her sleeping quarters, and returned with a piece of her blanket, with which she whipped the fruit into the cage. We can see, therefore, that this ape had learned to make use of objects similar to the ones that had been formerly used. ALSO, THE BOUNDS OF THE EFFECTIVE ENVIRONMENT INCLUDED MORE THAN WHAT WAS IN THE FIELD OF VISION WHEN SHE TURNED HER BACK UPON THE FRUIT TO PICK UP A STICK. The fruit still existed for the ape, even when not seen.

An incident involving a feeble-minded maid illustrates a failure to make such substitutions as we have seen in the case of the ape. This maid, left to care for some small children at a lake resort, decided to take them rowing. She said that her sweetheart had shown her how to row a boat. The boat available at this time, however, had no oars but was propelled by paddles. After depositing the children in the two ends of the boat, she sat in the middle seat, with a paddle in each hand, and pushed on the bottom of the lake until the boat was beyond the depth of the paddles. Then she began to cry. A ten-year-old boy in the boat who had seen the men paddle it, finally got one paddle away from her and brought the boat to shore.

Another problem situation was presented to chimpanzees. Fruit was hung in the center of the cage too high to be reached from the ground. At one side of the cage was a box, sufficiently high so that, if it were placed under the fruit, it would bring the ape within reach of the fruit. After reaching and jumping for some time, the ape climbed upon the box in its horizontal position. Sometimes he would climb on the box and then run to the center of the cage, as if he expected thereby to maintain

the desired height. Finally, he tumbled the box to the center of the cage, and thus reached the fruit. After this procedure had been learned, the fruit was placed so high that two or even four boxes, one on top of the other, were necessary. The need of building this platform was quickly grasped, but the ape showed little ability at first to make the proper structure. He would place on one box a second box with the open side up, and then climb into it without success. Or, he would place the boxes without reference to their size, or with one projecting too far over the side, one on top of each other; and the whole pile would tumble down (Figure 84).

The problem was within the scope of the animal, but it presented certain difficulties. He soon perceived that a higher elevation was necessary, but failed to recognize that he could not stand on a box far removed and maintain that elevation until he ran beneath the fruit. His next step was to correct this error by dragging the box over. Then, he failed to observe clearly the details of arrangement necessary to make a substantial structure. These experiments with chimpanzees demonstrate: (1) THE TRIAL-AND-ERROR CHARACTER OF PROBLEM SOLVING; AND (2) THE IMPORTANCE OF BEING ABLE TO PERCEIVE THE RELATIONS OF THE PARTS TO BE ORGANIZED IN THE SOLUTION.

These experiments with chimpanzees were repeated with a group of feeble-minded boys, approximately ten years old, who were rated by psychological tests as possessing the general intelligence corresponding to that of normal three- and four-year-old children. As a preliminary training for several days, these children were encouraged to play with brilliantly colored balls. They were then taken, one at a time, to the same room and left with no indication of what was expected of them, while the experimenter observed them through a one-way screen. In one experiment, the ball was placed on a cabinet out of reach, and the only movable object in the room was a stick. These boys differed in one respect from the apes in that they frequently talked: "I wish I had that ball"; "I wish Miss *G* would come back." The following report on one boy is typical: When he first discovered the ball, he reached for it and attempted to get it by jumping; he then backed to the opposite wall, ran

FIGURE 84.—THE ACHIEVEMENT OF A FOUR-STORY STRUCTURE. (*Köhler.*)

to the cabinet, and climbed into the window, which was too far away. Finally, while sitting in the window, he looked at the stick with which he had just been playing and looked at the ball. He promptly jumped down and, with the stick, knocked the ball off the cabinet.

The normal children three to four years old differed little in

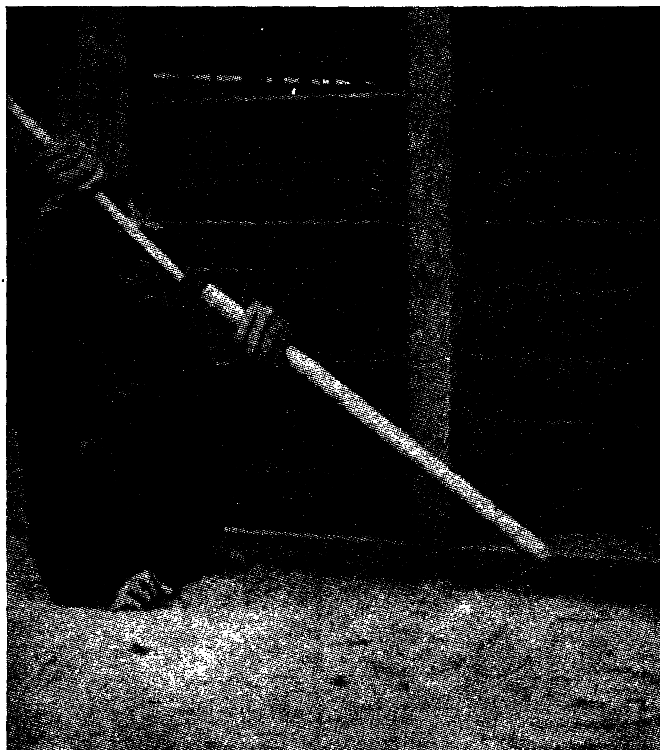

FIGURE 85.—SULTAN MAKING A DOUBLE STICK. (*Köhler.*)

their behavior from the feeble-minded except that they displayed wide individual differences in home training and were physically smaller and less developed. The effect of home training is illustrated by one youngster who failed to get the ball when he was alone. He merely stood in one place and looked at it. When Miss *G* returned, he said: "I wish I could have that ball." When she said: "Get it, then," he promptly

picked up the stick and knocked the ball off the cabinet. EVIDENTLY, THIS CHILD HAD LEARNED AT HOME THAT HE MUST NOT TOUCH THINGS WITHOUT PERMISSION. IF THIS POINT HAD NOT BEEN OBSERVED, IT WOULD HAVE BEEN ASSUMED THAT A FEEBLE-MINDED BOY WITH THE INTELLIGENCE OF A THREE-YEAR-OLD COULD SOLVE THE PROBLEM MORE EASILY THAN A NORMAL THREE-YEAR-OLD COULD.[3]

When chimpanzees had learned to get food from outside the cage by raking it in with a stick, one subject was given two sticks, neither one of which was long enough to reach the fruit; but the two sticks could be fitted together to make one long stick. For over an hour, the chimpanzee made various attempts to get the fruit, using one stick and then the other. Finally, he retired to a box in another part of the cage. In a few minutes, he began to play with the sticks and, during this manipulation, managed to insert the end of one stick into the end of the other. When this occurred, he promptly ran to the bars of the cage, to which he had up to now half turned his back, and promptly drew in the banana. The sticks then fell apart, whereupon he connected them again. The next day, only a short time was required before he again was able to utilize the jointed-stick procedure (Figure 85).

Insight in problem solving

Throughout the experiment with puzzles and other problems, it has been pointed out that one important feature is the ability to recognize elements that are important to the solution. In some situations, this is more difficult than in others. For example, when working with the bent nail, the problem is so simple in some respects that mere manipulation seems to be all that can be expected. It is apparently difficult for most subjects to see the relations in three dimensions as they exist here. On the other hand, the unicursal puzzle (Figure 81) may be studied; and, without any explicit manipulation, the subject may finally observe the correct procedure. This

[3] Aldrich, C. G., and Doll, E. A., "Problem Solving among Idiots," in *Journal of Comparative Psychology* (1931), Vol. XII, pp. 137–170.

amount and kind of manipulation, however, may not be sufficient to solve the problem at the first trial.

In experiments with animals, we have seen that, at first, only very simple relations can be observed. Some features are never discovered because another less desirable response succeeds in a fashion. For example, in one experiment with monkeys, they were supposed to press a series of triggers in order to open a box. It was evident, after a number of days, that this problem was too difficult, either because there were too many levers to be operated or because the levers were too small to be identified with the problem. One monkey pounced upon the box and shook it so vigorously that it opened. Afterward, this was the only method that he would employ. In the jointed-stick experiment, it is quite probable that, if this animal had not used sticks for raking in food and if he had not been recently attempting to get the food with these two short sticks, he would not have seen the relation between the sticks joined together and the success of the resulting long stick.

Stimulus patterns as problems

Another type of experiment requires that the subject discover the pattern of a series of events. For example, a series of numerals might be presented such as the following:

1 3 5 7 — —
1 4 9 16 25 — —

The subject is to write the next two numerals that continue the progression indicated.

In an early experiment with animals,[4] a box was constructed with a row of keys hidden from the subject. Any number of these keys could be pushed out in view of the subject and could be connected with an electric buzzer, which indicated the correct response. If, therefore, keys for 1 and 3 are exposed, and 1 is connected with the puzzle, the animal may press the keys in any order, but the buzzer sounds only when he presses key 1. In the next trial, keys 3, 4, and 5 may be exposed. Here

[4] Yerkes, R. M., *The Mental Life of Monkeys and Apes,* Behavior Monograph No. 1 (1916), Vol. III, pp. 1–145.

number 3 is the correct key. The problem is to determine how quickly the subject will learn, or "catch on," that the correct response is always the first key in the series for this particular problem. Then, the experimenter sets up a new series in which the correct key has some other relation to the keys exposed, and the experiment is repeated.

When two monkeys and one ape (orangutan) were used as subjects, an interesting feature of the results was that the monkeys learned the first series more readily than the ape did. They also displayed normal learning curves. The ape, on the

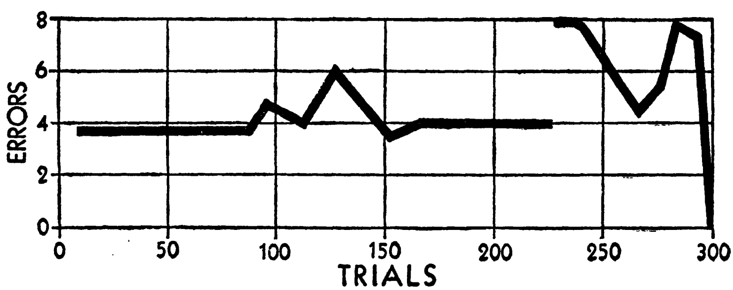

FIGURE 86.—CURVE SHOWING THE PROGRESS MADE BY AN APE TOWARD MASTERY OF A MULTIPLE-CHOICE PROBLEM. (*Yerkes.*)

other hand, after more than 200 trials, seemed to profit very little by the repeated test. Then there was a sudden increase in errors for a number of trials, followed by a sudden drop (Figure 86). When a new series was given, the monkeys were unable to profit by the preceding series, while the ape "caught on" rather quickly. This is taken as evidence of the superiority of the ape in the type of problem requiring the perception of relationships.

The same type of experiment has been adapted to human subjects (Figure 87). Any number of keys may be presented, and the pattern made as complicated as desired. The subject is instructed simply to find the key that sounds the buzzer. He soon surmises that there is a plan to the series and sets out to discover it. He also may verbalize, either silently or aloud. Although human subjects show great individual differences in time required to hit upon the plan and in ability to solve the

more complicated series, they are—as we might expect—considerably superior to the apes. One interesting feature of the human performance is that, often, the manipulation of the keys

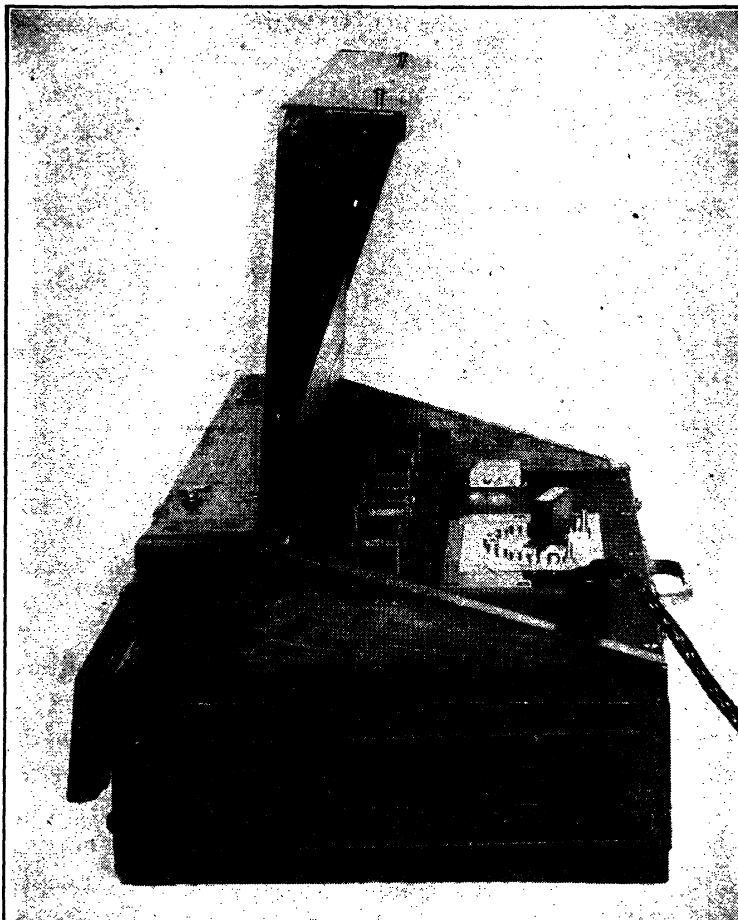

FIGURE 87.—THE YERKES MULTIPLE-CHOICE APPARATUS FOR HUMAN SUBJECTS. (*Modified at Ohio State University.*)

interferes with the solution. Another subject observing the performance will hit upon the plan more quickly than the manipulator. Evidently, the human subject arrives at the solution more readily when it is not interfered with by his manipulating the keys. THE PROBLEMS CAN BE SOLVED BY VER-

BALIZING, A METHOD FREQUENTLY USED BY THE ADULT HUMAN IN ALL KINDS OF PROBLEM SITUATIONS. IN THIS VERY IMPORTANT RESPECT, THE HUMAN IS DIFFERENT FROM AND SUPERIOR TO ALL OTHER ANIMALS.

This sort of problem arises in everyday life. Take, for example, the expansion of the binomial $x+y$ raised to the nth power. By the process of multiplication, you have discovered that:

$$(x+y)^2 = x^2 + 2xy + y^2$$
$$(x+y)^3 = x^3 + 3x^2y + 3xy^2 + y^3$$

How far would it be necessary to carry these multiplications in order to write the expansion of $(x+y)^n$? As soon as you perceive the relationships present in the problem, the solution will not be long in appearing.

You also observe a friend in a number of situations. If you are dealing with him intelligently, you discover that, when a certain combination of events occurs, he will behave in a certain manner. You discover, in other words, a formula for his behavior.

Problem solving is reacting

It is a popular notion that there is a wide difference between such activity as the solution of a mechanical puzzle or the construction of any mechanical device and what we consider thinking. In none of the examples so far presented is there any real distinction in this respect. We may solve the problem by the use of our fingers, or with pencil and paper, or by talking, or by no explicit response so far as any observer can determine. For example, you ask a question, and your friend remains silent for some time before he gives you an answer. You say that he has been "thinking"; but this thinking has involved activity, either in the form of words or other symbols that have been manipulated implicitly. That this is true is exemplified by a number of studies of imagination and reasoning.

Eye movements in thinking

One convenient type of response for objective study in connection with imagining and thinking is the recording of eye

movements. If a watch is held to one ear and then to the other, and the subject is asked to listen to the tick, you can observe that the eyes turn in the direction of the watch. A more exact method of study is to photograph the eye movements. The head is held in a fixed position, and the camera is set up with a moving film that will record the position of a white spot fixed upon the cornea of the eye.[5]

When a subject is asked to imagine a train passing across the landscape, the eye movements are in a horizontal direction. When he is asked to imagine a bird flying across a field, the movements are horizontal, but more or less zigzag in a vertical plane, according to whether he imagines the bird to be flying a straight course or a series of turns. If he imagines an airplane soaring overhead, the eyes turn upward. Such movements and combination of movements of the various members of the body are believed to comprise the explicit reactions that are involved in thinking.

The place of language in thinking

That words are used many times in problem solving is evident from the observation of children, who are very likely to do their thinking aloud. At the end of a summer vacation, a little girl stood with her father on the deck of a ferry, homeward bound, and observed a row of buckets filled with water. She asked her father what the water was for, and he suggested that she answer that question herself. This she did in the following manner: "The water is put there to drink. No, that fountain over there has drinking water. This is dirty water and has no ice. They are to put fish in. The pails aren't big enough. [Remarkable as it may seem, her father had been fortunate in bringing home only big fish during the summer.] It's for the horses to drink. There aren't any horses on this boat. It's for the engine. The engine is down in the bottom of the boat, where there is lots of water. They use it to scrub the floor." This seemed to satisfy the little girl, although the

[5] Totten, E., *Eye Movements during Visual Imagery*, Comparative Psychology Monograph No. 3 (1935), Vol. XI.

water was really for use in case of fire. Two factors in reasoning are demonstrated by this illustration:

1. The solution of the problem involved a number of trials, which were discarded one by one until the proper reaction—that is, one satisfactory to the little girl—was made.
2. Language may be used as an effective tool in dealing with a problem.

The bent-nail puzzle was presented to a number of students working in pairs in the laboratory, with the instructions that they should lay the puzzle upon the table and study it until they thought they could solve it without preliminary manipulations. In every case but one, approximately as much manipulation was necessary after the nails were picked up as would have been required if they had not been examined at all. The one exception is significant: Two of the students drew pictures of the nails and labeled the parts; then they wrote the movements necessary to take them apart. After a number of trials, they decided that they had discovered the solution; they picked up the nails and took them apart with very little manipulation. It is evident that, so long as the students had no means of talking about the problem, they were not able to solve it.

Investigations of implicit behavior

These descriptions suggest the importance of verbalizing in human thinking. To test this hypothesis more thoroughly, we have recourse to experiments involving a finer technique, which was made possible by the recent methods of amplifying very weak electric currents. In one series of experiments, the subjects [6] were trained for a long period in relaxation. If you lie down on a couch and attempt to relax, most of the muscles of your body would be more tense than you realized; and the variation in this tenseness would be too great to allow for any

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[6] Jacobson, Edmund, *Progressive Relaxation* (Chicago: University of Chicago Press, 1929), especially pp. 165–189. Also: "Electro-physiology of Mental Activities," in *American Journal of Psychology* (1932), Vol. XLIV, pp. 677–694.

recording of the finer movements that might be involved in thinking. When the subject had acquired the skill of relaxing to a maximum degree (as indicated by very fine electrical measurements reflecting muscular activity), he was asked to imagine throwing a ball three times with the right arm. Although he made no movement that could be observed by either himself or the experimenter, there was a definite increase in the amplitude in the record corresponding to this instruction. The electric recording apparatus is simply more sensitive than the subject's own sense organs.

If the electrodes, instead of being placed over the muscles in the arm to be examined, were placed on the throat, over the vocal apparatus, records of contractions would indicate that thinking was accomplished by movements corresponding to those that would be made in actual speech. Such evidence indicates that the earlier conception of thinking and imagining as purely brain processes must be discarded. ALTHOUGH THE BRAIN IS A VERY ESSENTIAL ORGAN IN THINKING, IT SHOULD BE CONCEIVED AS A CO-ORDINATING CENTER FOR THE EXTREMELY COMPLEX BEHAVIOR OF THE TOTAL ORGANISM. THE THINKING, THEREFORE, IS REACTION.

Abbreviated reactions

The reactions in thinking need not be complete. There is always the tendency in thinking, as in other behavior, to reduce the movements to the minimum, whether they are implicit or explicit. This is very much the same as in the case of an animal in a puzzle box. For example, the task set for one dog was that he lie down. Immediately, the door would be released and he could come out to food. The dog learned this through a process of becoming discouraged, lying down as if giving up, and then finding that the door had been opened. After many trials, he would immediately lie down when placed in the puzzle box. From this point on, *lying down* had to be defined, because the dog would ease himself toward the floor as if to lie down, without actually doing so.

We see the same process of abbreviating in the development of written language. The earliest writing was in the form of

pictures that were fair representations of the objects portrayed. These were gradually reduced to symbols that now show only slight resemblance to the originals. In the Chinese language, for example, *house* is represented by the upper portion of Figure 88 A; *man* by the two lower strokes of the left part of Figure 88 B; and a *man going forward* by the addition of the stroke above. Similar abbreviations are recognizable in our own language in everyday use, both oral and written, such as the careless slurring of syllables and the omission of endings.

Implicit reactions may be still further reduced, so that the self-stimulation—whether in the form of talking to oneself or in the form of other bodily movements—occurs very rapidly. It takes only a fraction of the time that would be consumed if all of the responses were explicit and were carried to completion. This reduction in time has given rise to the popular notion that thinking occurs with the "speed of light." People are inclined to believe this fallacy because they fail to take into account the rather enormous saving made possible when words and other symbolic movements come to stand for other, more involved reactions. Thus, when you are studying a problem, you may say: "This way," "Up," "Right"—rather than give a complete sentence that would be necessary to be intelligible to another. A slight movement or an incomplete vocal response may be all that is needed in thinking.

Thinking and the brain

It is generally conceded that man's superiority to other animals in his ability to think, solve problems, and create new ideas is due to his superior brain. We have previously indicated (pages 42–46) that the brain performs the important function of integrating the activity. If we should compare the brain of a chimpanzee with that of a man (Figures 11 and 12), we would observe that the great difference is due almost wholly to the enlargement of the human cerebrum. Those parts of the brain that function in breathing, digestion, and coordinating muscles and glands are very much the same in either species. We can also recognize, so far as bare living is concerned, that the chimpanzee is as well equipped as man.

Man's superiority is characterized by the great variety of responses he can make. He has been able to discover the course of the planets, to develop telescopes with which he can view heavenly bodies millions of light-years away. He has been able to develop the use of language and other symbols for communication. All this is due to the extreme development of the cerebral hemispheres.

It is not merely a matter of one stimulus leading to a specific response, but the fact that all stimuli in man's environment or all forces in his life space determine a variety of combinations which are well-nigh unlimited. In this sense, man *thinks with his brain*. Or, we may say that the variety of reactions to a new situation are made possible by the superior interconnecting relations of the human cerebrum, as compared with that of the lower organisms.

16

Thinking (Continued)

Experiments in Generalizing and Abstracting

Development of concepts

A young child may be presented with a small, furry animal and at the same time hear the word *kitty*. With frequent repetitions of this situation, the word *kitty* becomes associated with this animal. If another small, furry animal is presented, it too will be called *kitty*. Further experience with cats, rabbits, and dogs of various sizes and colors results in a distinction among these. Some animals are cats, others are rabbits, and still others are dogs. Somehow, those characteristics that are the attributes of a cat have been *abstracted*. The child has developed his concepts of *cat* and *rabbit*, and so forth. A CONCEPT IS A PATTERN REACTION TO A SITUATION WHICH CONTAINS AN ELEMENT PREVIOUSLY COMMON TO A NUMBER OF OTHER SITUATIONS. The stimulus that gives rise to the concept-response is very much like the "suggestion" we discussed in an earlier chapter.

The child also *generalizes* in his application of this abstraction to all cats. In the same manner, we develop a generalized abstraction, or concept, of triangularity and sphericity. We are confronted with triangles of many sizes and shapes. Marbles, balls, and globes are of various sizes and colors. From these, we learn to abstract *triangle* as three-sided or three-angled, and *sphere* as "round solid." We generalize from these situations when we apply this concept to other objects that

possess in greater or lesser degree the abstracted characteristic.

In a similar fashion, we form such generalized abstractions of *peace, honor,* and *virtue.* That these are the result of meeting with certain characteristics in many situations can be shown by examining what one means by the term used. Usually, when a person is questioned as to what he means by *virtue,* he will reply by giving an example. If he is further pressed, he will give several examples. *Honor,* for some persons, is expressed only in personal courage in defense of one's country; while for others, it is a matter of veracity, and stealing and other

A B C

FIGURE 88.—CHINESE CHARACTERS WHICH POSSESS ONLY SLIGHT RESEMBLANCE TO THE OBJECTS OR SITUATIONS THEY REPRESENT.

criminal acts might be defensible. In other words, the generalization must be based upon the situations that the individual has met.

The origin of generalized abstractions is displayed in many Chinese characters. Thus, the word for *peace* is *one woman in a house* (Figure 88 A); *virtue* (B) is *a man taking a step forward with his whole body according to his heart*—that is, *behavior in complete accord with his conscience; good* (C) is *a woman and her son.* Each speaks eloquently the Chinese development of these particular generalizations.

Experiments in abstracting and generalizing

The following is a good example of an experimental study of the development of abstracting and generalizing: [1]

For his material, the investigator selected 144 Chinese char-

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[1] Hull, C. L., *Quantitative Aspects of the Evolution of Concepts,* Psychological Monographs, No. 123 (1920), Vol. XXVIII, pp. 1–86.

acters (Figure 89). These were printed on cards, and the cards were arranged in 12 packs. One character of each pack contained the same characteristic, thus making 12 hidden characteristics, each in 12 different Chinese characters of various degrees of complexity.

The cards of one pack were placed in an exposure apparatus and shown to the subject at the rate of one character every five seconds. Two and a half seconds after the beginning of an exposure, the experimenter pronounced the nonsense

FIGURE 89.—CHINESE CHARACTERS USED AS MATERIAL FOR STUDYING THE FORMING OF HABITS AS GENERALIZED RESPONSES TO ABSTRACTED STIMULI. (*Hull.*)

word corresponding to the character. The subject was instructed to learn the word of each character and try to anticipate the instructor in pronouncing it. When the first pack had been learned, the second pack was exposed. The hidden characteristics and names were the same as in the preceding list, but the total characters were different. When this had been learned, the third pack was used; and so on for the first six packs. In every case, the hidden characteristic and name were the same. The subject, however, was not informed of this fact or of the purpose of the experiment.

After the first six packs had been learned, the other six were used to test the subject's development of the generalized ab-

straction. The number of characters that he could name correctly was taken as a measure of this development. The number of repetitions required before he could anticipate the experimenter in naming the characters in the learning series was also taken as a measure of the evolution of the generalized abstraction.

Efficiency in development of generalized abstraction

Several problems arose out of the above experiment. The first one that the experimenter attempted to solve was whether, in evolving a new generalization, it is easier to proceed from the simple to the complex or from the complex to the simple. It is a general maxim of education that we should begin with simpler forms and work up to the more complex. In order to test this hypothesis, half of the material was arranged in the order of simple to complex, and the other half in the order of complex to simple.

The results show that, in the evolution of such generalized abstractions as were here involved, simple experiences are more efficient than complex ones, regardless of whether they occur at the beginning or the end of the process of evolution; but that the simple-to-complex order is no more efficient than the complex-to-simple order, if we neglect the time necessary to master each character individually. It would seem, therefore, that the simple experiences are important wherever they occur in the series.

Isolated versus hidden element

A second problem in the development of generalized abstraction is whether the individual is assisted by having the hidden character isolated for him. Is it more efficient to spend a given amount of time in learning the reaction to the abstract characteristic, as yet not experienced in its concrete setting, or to spend the same amount of time in perfecting reactions to a series of concrete situations? The theory has been that, to have functional value, the abstraction must be evolved from the concrete by each individual himself. Some situations produce pain; others bring satisfaction. The child must learn

that stoves are hot and that animals bite by meeting these situations.

This problem was attacked by the presentation of series of Chinese characters—as in the previous experiment—except that, in place of half of the characters with their hidden characteristic, this characteristic, or element, was presented alone. That is, the first six characters remained the same, but only the common element was used in the last six. When these had been learned in the manner of the previous experiment, the six test packs were used to determine the relative functional efficiency of the two methods.

Of the two methods compared, there was no clear-cut advantage in either so far as generalized abstraction is concerned. However, the ability to define the hidden element was greater for those elements that had been given outright. If, however, the hidden elements were given alternately—that is, first the common element alone, then the total character, and so on—the latter method was found to be distinctly more efficient.

Several questions regarding the evolution of generalized abstractions were also investigated by this method. Hull has demonstrated quite conclusively that the whole problem of the "higher thought processes" can be investigated in the laboratory as effectively as we have investigated the simpler processes of learning. A great proportion of our educational endeavor is for the purpose of developing abstractions, general principles of thought and action; and it is exceedingly important that we know more definitely what are the best methods of evolving these principles.

Thinking in Everyday Life

Creative thinking

After having read this far, you may still believe that man is capable of more in his thinking than merely reacting to stimuli. He is able, you say, to create new things and have new ideas. You point to the artist and the poet, or to the economic theorist for your examples. We are inclined to look upon the inventor and the scientist as persons who can discover new

things in a different way from the ordinary person. Invention, however, is also a matter of trial and error, of response to a problem situation. Man has seen birds fly. When the problem of greater speed in transportation arose, the inventor constructed wings, which he attached to his own body; but, one by one, such methods proved to be failures. Then, the inventor perceived that kites glide in the air, and numerous designs for gliders were constructed. What was needed was power to keep the glider in motion, and other important details for gliding and balancing the whole contraption.

This seems like a simple process of developing the modern airplane, but the Wright brothers would never have succeeded if other inventors had not constructed the gas engine and if scientists had not discovered how to make gasoline. Every great invention is a rearrangement of facts that are already known. THE CHIEF CHARACTERISTICS OF THE INVENTOR ARE THAT HE PERCEIVES THE DESIRABILITY AND POSSIBILITY OF A NEW MECHANISM AND IS ABLE TO TAKE NEW DIRECTIONS. Others are not inventors because they either fail to observe the need or their habits of thinking and acting are fixed in limited channels.

We have seen before that the chief difficulty in the solution of a puzzle is the restriction in the individual's activity. He persists in doing the same thing over and over, rather than varying the attack upon his problem. He exhibits too much perseverance, while the inventor will more readily discard one attack and turn to another until he succeeds. A further factor in invention is that the inventor is in a position to perceive the need or desirability. The director of research in a great automobile corporation is successful as an inventor in that field partly because of his intimacy with every demand. He would not necessarily be as successful as an inventor in a field in which he was unfamiliar. The characteristics, therefore, of a good inventor are:

1. He is alert to his environment and sees possibilities of change.
2. He is curious regarding what might be, rather than accepting or taking for granted what already exists.
3. He possesses the tools or secures them—that is, he has knowledge of a variety of principles that can be used, or he proceeds to discover them.

4. He makes a variety of responses, discarding them one by one until he hits upon the correct solution.

The artist is more than a painter of pictures. The camera is a good instrument for reproducing, but the artist attempts to do more than reproduce. You will usually find it difficult to discover his problems and his methods of attack, because

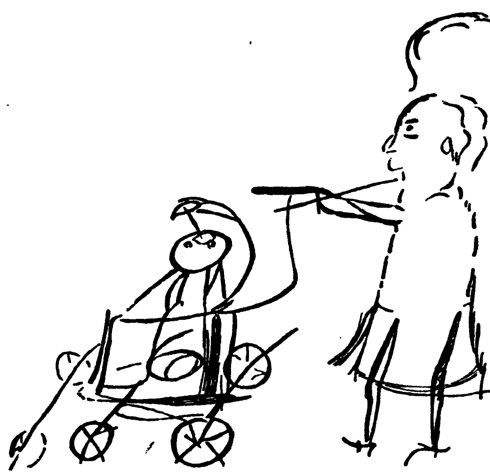

FIGURE 90.—"A GIRL PUSHING A BABY CARRIAGE" AS DRAWN BY A SCIENTIFICALLY TRAINED ADULT. Note the confusion of perspective, transparency, and remnants of unsuccessful attempts.

so much of his work is not verbal. Frequently, what he paints is intended only as a suggestion of what you are to "see." When he paints a picture, you may feel that it is distorted. It doesn't look like the model. If it is a portrait, he will tell you that he is portraying character. If it is a landscape, he attempts to portray something that cannot be seen by the ordinary observer. HIS REASONING PROCESS, HOWEVER, IS VERY MUCH THE SAME AS THAT OF THE INVENTOR. HE MUST ORGANIZE THE MATERIALS HE WISHES TO USE. These may consist of lines or colors.

A good example is illustrated in the two accompanying sketches. Figure 90 is taken from a series of similar sketches

made by trained scientists upon the request of a psychologist, who simply asked them to draw a picture of a "woman pushing a baby carriage" or "a man riding a horse." Figure 91 was made by an artist who was given the same instructions. The

FIGURE 91.—"A GIRL PUSHING A BABY CARRIAGE" AS DRAWN BY AN ARTIST.

procedure in the two cases was entirely different. The scientists made their sketches very much as a child would. They drew one part—the baby carriage, for example—and then drew the sketch of the woman; or their perspective was so unusual as to be almost gruesome. Sometimes there was no

connection between the woman and the carriage; or the legs were drawn first and show through the woman's dress, a sort of X-ray picture. The artist proceeded to organize the sketch as a whole. He talked as he sketched, and his verbalizations indicated as well as the lines drawn that he was dealing with the relation of one part of the sketch to another. "I have to have the woman pushing the carriage some place. I seem to think of her in a park."

Other evidence of creative thinking by the artist is his constant attempt to develop something new in art. As a result, we have many "schools of art." Some of them strike the uninitiated as absurd. Here, again. WE FIND THE CREATIVE THINKER REACTING TO THE NEW SITUATION WITH THE MATERIALS THAT HAVE BEEN USED IN OTHER COMBINATIONS.

The poet creates by reacting in a variety of ways in an attempt to develop a new style or a poem that is original in other respects than simply as a new topic. For example, he may see a child on the street brutally treated by its parents. This makes a strong impression upon him, and he thinks about it from time to time, trying to formulate an expression of his emotion, with the child as the subject. Perhaps a year later, he sits down and writes the poem with little hesitation. Or, he may set out to write a poem without first selecting a theme. In this case, he may organize all the factors that he considers pertinent to a poem. Edgar Allan Poe, in his essay on the *Philosophy of Composition,* relates how he composed *The Raven.* First, he decided that a poem should be not longer than about one hundred lines. The next step was to determine what effect was to be produced—truth, passion, or beauty. He chose beauty. The third consideration was the emotional tone, which he decided should be sadness or melancholy to "excite the soul to tears." To produce the desired artistic effects, he chose the refrain. The nature of this refrain should be a single word. Now, the most sonorous sound seemed to be the combination of the vowel *o* with the consonant *r*. *Nevermore* embodies both the sound and the melancholy desired. But what pretext can be given for a poem with the refrain *nevermore*? The student can go on from this

point. The total essay illustrates that a poet's reasoning processes in composing a poem parallels the reasoning of a scientist or an inventor.

One feature suggested by the poet's writing his poem almost spontaneously after a year's time is that spontaneity, whether in an invention or in an artistic discovery, is based upon a background of experience. A mathematician, for example, reported that he had been working on a problem for many days. Then, one evening, while out for a walk with his wife, the solution "spontaneously" occurred to him. The significance of this is, not that the solution occurred out of "thin air," so to speak, but that the mathematician had been working on the problem. HIS LONG HOURS OF PERSEVERANCE HAD BROUGHT TOGETHER A GREAT DEAL OF MATERIAL THAT NOW SUCCEEDED IN TAKING SHAPE TOWARD THE DESIRED END.

Psychologists, of course, do not know exactly what mechanisms in the body are responsible for this phenomenon. This ignorance does not mean that we must not try to describe it when it appears in behavior. The layman is a little impatient with this cautious approach. He would rather not wait to find out what the basis for the effect is. And so you will hear people talk in terms like these: "The ideas were in my subconscious all of the time; and as soon as I let them up, the solution came to me"; "His mind was almost inactive for a long time; and then suddenly it sprang into action, and his problem was solved in no time"; "I don't understand why his mind doesn't grasp those ideas"; "It seemed almost as though his intuition had deserted him." These phrases are picturesque, impressive, and scientifically useless. They give satisfaction and are widely used because they appear to be the solution to perplexing problems.

Imagination and reasoning

We frequently hear such expressions as: "He has no imagination"; or: "He used his imagination in solving his problem." When we say that he has no imagination, we signify that one is unable to respond to more than the immediately presented details of a problem. There is no recombination of past ex-

periences; there is no response "as if" other stimuli were present. On the other hand, when we say that "he uses his imagination," we imply that he reacts in terms of elements not immediately present in his problem. Sometimes the distinction is made that *reasoning* deals with a real situation and that the outcome will be true to reality, while *imagination* is a similar process of relating old experiences in a new way; but the conclusion is not necessarily a valid one. Thus, we might say that the process of thinking whereby Mark Twain invented the airship that took Tom Sawyer and friends abroad was that of *imagination,* while the invention by the Wright brothers was the result of *reasoning.* The former recognized that his invention had no basis in reality, while the latter had sufficient faith to construct the ship and risk their necks in it.

There is a second difference closely related to this: In imagination or fantasy thinking, the defects in organization can be ignored. When Tom Sawyer wished his ship to go higher, he pressed a button. What the button did was not important. The speed of the ship was regulated by getting into the proper air current. The actual existence of these currents was again nothing that needed investigation. The inventor, on the other hand, must check every new principle. He may make an error; but so far as he knows at the time, the invention will work—that is, it conforms to his knowledge of the principles involved.

Straight and Crooked Thinking

Perhaps now we are ready to assemble the principles we have been discussing into a meaningful pattern that will have some application and usefulness in our everyday lives. It is not uncommon to find a person who believes that the psychologist should be able to tell him how to think. Such a person is a little disturbed to learn that the psychologist has little to offer on *how to think;* he is better equipped to tell *what thinking is.* Perhaps, with this information available, we may be able to do a more efficient job of problem solving.

It is not the task of the psychologist to furnish a step-by-

step list of directions that will enable you to cope successfully with any problem you may meet; nor is he especially prepared to do so, even if it were his duty. To whom, then, may we turn for the rules of thinking? These rules are essentially the province of the logician, though not exclusively so. It is he who can tell you about premise, syllogism, analogy, generalization, deduction, induction, inference, antecedent, postulate, axiom, presupposition, conclusion, and the other tools by which formal thinking is done. "But," you may argue, "isn't it reasonable to assume that these bits of information about thinking which the psychologist has gathered should be of some use to us in evaluating our own thinking?" The answer is a simple: "Yes, it should be." But remember that evaluating your thinking and telling you how to think are two different things entirely. Also, remember that evaluation in this sense does not imply any particular system of moral or ethical standards. Perhaps this point will become clearer as we proceed.

Popular misconceptions

The psychologist can assure you that thinking is not the operation of a *faculty* of the mind—that is, psychologists *nowadays* can tell you that. Not long ago, psychologists, philosophers, scientists—indeed, nearly everyone—argued that reasoning was due to the operation of a special mental faculty. Not only that, but it was maintained that, since only man possessed a mind, only man could reason. The lower animals were believed to be governed in their actions only by "blind instinct."

We have referred to this point before in our discussion, but we should be reminded of it again because we make a bad mistake to assume that we are examining an item of history when we observe these earlier conceptions of thinking. These beliefs are still with us today. They are held by an undoubted majority of the people with whom you come in contact. As a matter of fact, you yourself probably thought of thinking in somewhat these same terms. You will undoubtedly continue in such a belief unless your instructor or this

book is convincing enough to make you believe otherwise. That the mentalistic attitude toward thinking is still very common is indicated by the popular attitude toward it, as expressed in such phrases as: "He doesn't seem to have any analytical faculties"; "She has a beautiful face and figure but a dull mind"; "He has a mind like a steel trap"; "Use your powers of reasoning, and get out of this scrape yourself."

Educational systems

Another evidence that people think of reasoning as a faculty lies in their attitude toward its development with age. In scolding a child for some infringement, a parent will say: "You're old enough to know better"—as though age alone were enough to assure a satisfactory development of an ability to solve one's problems competently according to accepted standards. One of the functions of the schoolteacher was that of speeding up this development. Children were sent to school to "sharpen their wits." It seemed to make little difference what the intellectual grindstone was, as long as it was hard.

As a result, for many, many years, our school curricula were cluttered with "disciplinary" (mind-training) courses. Many of these courses were (and in some localities still are) required, not because it was believed that the content of the courses would be useful later, but because they furnished opportunities for daily mental gymnastics that not only kept the mental faculties in robust, vigorous "health" but also speeded up any sluggishness that might result in unwanted retardation of the development. In other words, these procedures were designed to teach children "how to think." For a long time, most people believed that they were doing just that. It was not until some carefully controlled scientific inquiries were made that it was discovered that pupils who had had this rigid mind training were not much better thinkers than others who had not had the time or opportunity for this training. This was a most severe blow to many educators, because it meant a complete rearrangement of the whole process of education. Some school systems have not even yet seen the implications of these findings, and are continuing in the old traditions.

Others have swung to the other extreme, and make no specific requirements in their curricula; the student studies what he wants to, and only that.

If children were not being taught to think in school, what was it that they were getting? The experience seemed to be doing some of them a lot of good. When the answer to this question was sought, it was found that school was an excellent place to learn, a place to learn many more things than could possibly be acquired around the average home. What was it that was being learned? In the lower grades, there were skills—skills of writing, spelling, reading, and the manipulation of numbers. Later, there were facts—facts in history, biology, civics, science, and perhaps some facts about their own language. There were also principles or collections of facts, laws, and some more advanced skills, some of which directly related to earning a living. To us, nowadays, it is easy to see why the illusion of thought training was so easily accepted and readily believed in. In the present chapters, the dependence of problem-solving activity upon the past experience of the individual has repeatedly been emphasized. *Past experience* means everything it implies. It means all of the things that one has learned—the words, the formulas, the skills, the methods, the facts and principles, the laws, and every other bit of behavior that has been acquired. THE RICHER AND MORE VARIED THE EXPERIENCES, THE MORE VARIED WILL BE THE RESPONSES TO THE PROBLEM SITUATIONS AS THEY OCCUR IN THE FUTURE, AND THE GREATER THE CHANCES OF ARRIVING AT ADEQUATE SOLUTIONS.

This is not the entire story, however. Educators were not long in discovering that facts and principles and skills do not exist in a vacuum. This realization has lead to laudable present-day methods of teaching these things in their familiar settings—that is, in the setting in which they will most likely be encountered after school. Here the educator comes as close as it is possible to come to teaching people how to think. HIS ANSWER TO THE QUESTION: "HOW MAY WE TEACH PROBLEM SOLVING?" HAS BEEN TO GIVE OPPORTUNITY FOR PRACTICE IN PROBLEM SOLVING OF THE KIND THAT A STUDENT MUST DO

WHEN HE LEAVES SCHOOL. This is absolutely sound psychologically. As we have seen in the preceding chapters, what happens in the problem situation is a direct reflection of the past of the organism—excluding, of course, the developments attributable to chance alone. The past of the individual includes, not only the facts and principles that he has learned, but also his experience in problem solving itself. Of course, the educator's problem is complicated somewhat by the fact that he is unable to predict all of the problem situations that students will meet with after their schooling is over. All he can do, therefore, is to encourage practice in as many different situations as possible, draw up what he might call "generalized procedures," and hope for the best.

A college professor of physics was mightily pleased to discover that his daughter was getting (without his help!) a "straight *A*" in her high-school physics course. His elation was short-lived, however. On one Saturday morning, shortly after arriving at his laboratory, he received a call from his daughter that her bicycle had finally arrived. Could he please come home and take it out of the crate? He said that it would be impossible for him to leave, but that she should have no trouble uncrating it herself if she used the tools on his bench in the basement. When he arrived home at night, he was surprised to find the bicycle still uncrated and his daughter very much irritated by the fact that she had been unable to remove the boards from the crate and use her new bicycle. Using a long-handled screw driver which the girl had also used, he very easily pried off the ends of the crate. He realized that there was little strength involved in what he was doing and that the girl should have been able to do the job herself. She knew what a lever was. As a matter of fact, while watching her father, she told him what class lever he was using and the ratio of the force he was applying to the force at the other end of the lever. But it had never "occurred" to her to use a lever like that! In school, all their work with levers had been done with meter sticks with weights suspended at various points to demonstrate the "Law of Levers."

Limitations set by training

Up to this point, we have spoken in a vein that would indicate that one's background has only a desirable or advantageous effect upon one's thinking. This is not necessarily true. NOT ONLY DOES ONE'S PAST EXPERIENCE FURNISH BASIC EQUIPMENT FOR MEETING FUTURE PROBLEMS, BUT IT ALSO SETS CERTAIN LIMITATIONS UPON THE NATURE OF THE SOLUTIONS ONE WILL ULTIMATELY BE ABLE TO ATTAIN. This is a rather subtle aspect of thinking, and a frequently disregarded one. If we overlook it and treat a human only as though he had a mind that was infinitely capable, we should be neglecting a very important feature of the training of every human being. Unless we furnish the individual with a background of experiences, he is left with absolutely nothing but a lot of elemental vegetative processes to fall back on when, at some time, he finds himself in a problem situation. Following this proposition, it becomes axiomatic that an individual is limited in his thinking and reasoning by the past experience he has had. This is a hard fact for some of us to accept. Yet, it is true that we are continuously acknowledging it in our everyday lives. When the washing machine breaks down, mother simply postpones the laundry and waits for father or brother to fix the machine when he comes home in the evening. She would not even consider trying to do it herself, because "she doesn't know the first thing about machinery." It would not be difficult to find hundreds of illustrations of this kind from things that happen all about us from day to day.

Opinions

When background in certain fields is completely lacking, it is usually not hard for us to avoid or withdraw from those situations that require an experience we have not had. A real danger arises, however, when a partial background or an incomplete framework of experience creates the illusion of competency. We occasionally recognize this danger in others, but it is very difficult for us to see it in ourselves. You may have heard it said that "a little knowledge is a dangerous

thing." The danger lies in the fact that the possessor of bits of information actually feels that he is well informed; that he is competent to pass judgment, to solve problems. It is very difficult to destroy that illusion. If you were to intimate to a friend that he was only partially equipped to meet some of the problems for which he already has immediate answers, you would soon lose that friend! An inadequate background or an experience with glaring omissions is not a thing of which to be proud. Most of us "cover up," therefore, by simply refusing to admit that our experience does not qualify us to cope with certain problems.

It is part of the legend of a democracy that "every man has a right to his own opinion." To be accurate, this statement should read that "every man has a *legal* right to his opinion." Many of us, however, forget to include that restriction, especially when we apply it to ourselves. Polls of public opinion are continually running into this interesting refusal to admit an inadequacy. "Do you think the recently completed reciprocal trade treaties with Canada are a good or a bad thing for the American farmer?" "Which do you think is the most to blame for the depression: business management, labor, or the Government?" "Who do you think will win the war?" "Should the Government further restrict the importation of (coffee, sugar) into this country?" Of course, the "correct" answer to these questions is a simple: "I don't know." Yet, only about one in sixteen persons gives this answer. Why? First, because each of us has a legal right to express an opinion; and, second, EACH OF US HAS JUST ENOUGH PART INFORMATION TO CREATE THE ILLUSION OF ADEQUACY TO DEAL WITH THESE PROBLEMS.

A further danger arises to plague us: THERE SEEMS TO BE NO RELATIONSHIP BETWEEN THE DEGREE OF ASSURANCE WITH WHICH WE EXPRESS OUR OPINIONS OR HOLD OUR BELIEFS AND THE AMOUNT OF PERTINENT EXPERIENCE THAT WE CAN OFFER TO BACK THEM UP OR BASE THEM UPON. We like to think that, if we are moved deeply enough by our convictions, they must therefore be right. That this does not necessarily follow is shown by investigations in which attitudes and opinions have

been measured or examined, and then questions asked as to the basis of the expressed belief. These studies show that an opinion expressed very convincingly or a belief held to very tenaciously may, as often as not, be based upon a single instance, a rumor, a newspaper report, an account in a novel, an article, a book, or comprehensive reading and experience. A very healthy thing for you to do in the case of some of your own thinking would be to make a careful examination of the "facts" upon which your opinions are based. It will be hard for you to be honest with yourself in this matter; but if you do make a faithful attempt at such an examination of the bases for your own thinking, you will be amazed at the very meager background that many of them are founded upon. You will find much of your reasoning developing from more inadequate foundations than you would ever permit in a person who might be disagreeing with you.

Stereotype thinking

When you do examine your thinking and that of others, you will find that very much of it is done in terms of ready-made patterns. In every case, these patterns will be mirrors of your own past. The psychologist calls these patterns *stereotypes.* Others have called them *the pictures we carry in our minds.* REGARDLESS OF OUR NAME FOR THEM, THEY REPRESENT THE INTEGRATION OF PAST EXPERIENCES INTO A MEANINGFUL WHOLE. THEY ARE COMPOSED OF SCRAPS OF INFORMATION AND EXPERIENCE AND HABIT THAT HAVE BEEN PUT TOGETHER. They become immediately available when new situations arise that resemble in any way any part of the stereotype.

One of the dangers—an almost unavoidable one—inherent in the stereotype is that it encourages loose thinking and careless observation. Suppose, for instance, your thinking is pretty well settled, pretty well patterned with respect to some issue. You have "taken all the facts into consideration" and decided that a certain country or a certain class of people is in the state that it is today because of thus and so. These stereotypes may be identified by names—*democracy, communism, fascism, capitalism,* and so forth. All of your future thinking about

these individuals or this nation or that political party will be in terms of the stereotype already formed. The danger lies in the difficulty with which the stereotype is changed. If a new experience or a new encounter contradicts the stereotype, it is simply disregarded or twisted around by some interpretation that will make it fit into the old pattern.

Another danger in the use of the stereotype is that, if these patterns are at all common to any considerable number of people, everyone necessarily develops the same answers to problems that touch upon it. Or, if one person proposes a solution, others fall in line in agreement. When disagreement does occur under these conditions, it does not mean that one answer is any more correct than another. It means simply that the reasoning proceeded along different lines, in keeping with each of several different stereotypes.

How may stereotypes be eliminated or avoided? The answer is the same to both questions, and will be found at the basis of most of our educational systems: The solution lies in a broadening of one's background through the widest variety of experiences that it is possible for one to attain. One of the easiest places to do this is in school and college. There, in a comparatively small space, one is able to come in contact with a much wider variety of facts, information, points of view, and other forms of background than it is possible for the average person to experience in the ordinary contacts of everyday life. At home, we subscribe only to the newspapers and magazines we like; we read only the columnists with whom we already agree; we avoid discussions with others, for fear of losing friends. In college, we are required to read many things; we must learn much that is new, become thoroughly familiar with points of view that differ markedly from our own, and defend our opinions against expert opposition. If, after thoroughly and faithfully completing these assignments, we still think as we did, then our opinions carry much more weight and are more likely to stand the test of time.

It is a little discouraging to the student beginning his college career to learn that no one is very much interested in what he thinks about many things until he can show some evidence of

a background that will justify the conclusions he offers. Many students cannot endure this slight to their vanity, and give up in disappointment and disgust. Others discover that their college experience furnishes them with a rich variety of material that is obtainable in no other way and from which their thinking can develop along new and useful lines. IN THIS SENSE ALONE, IT MAY BE SAID THAT A COLLEGE EDUCATION TEACHES YOU TO THINK. If you care to have the "rules" of straight thinking stated a little more explicitly, perhaps the following list may help:

1. *Importance of accurate language habits.* We often hear the statement: "I know the answer but I can't express it." This may be true when one is dealing with a mechanical problem. A mechanic may be able to build a new machine that he cannot describe; he does his thinking with his hands. Most of our problems are dealt with in verbal symbols. You consider whether you should vote for one candidate or another; you try to decide what your view should be on economic or political problems; you must draw conclusions in your study of psychology if you are to do more than passively accept what you read or what the instructor tells you. Accurate vocabulary, the construction of the sentence, and the correct sequence are as necessary to clear thinking as is skill in constructing the parts and building a machine.

2. *Consider all the data.* Often, our thinking is faulty because we jump at conclusions or conceive of the solution as simpler than the facts would warrant. This is why the expert is more positive in his beliefs in other fields than his own. The political scientist would want to see all the data before he would be willing to voice an opinion on a new problem in government, although he might not hesitate to speak with finality on a psychological problem. The same trend is observable when we undertake the study of any new problem.

"Which is the most economical method of learning, by concentrated or distributed repetitions?" We hit upon an investigation which demonstrates that a judicious distribution of effort is better. The problem seems settled. Further search will uncover seemingly contradictory results. What

are we to believe now? A little investigation will show that the conditions of the two experiments were not the same. Still further search will reveal a variety of factors that need to be taken into account. Finally, we are led to give up our original dogmatic position and to accept something like this: "For some specific tasks, it is better to stick to it until it is mastered; but in general, time and effort will be saved by employing the distributed method."

3. *Watch your prejudices.* Another danger to clear thinking is the *will to believe.* When you pick up the daily paper and see one column devoted to the Nazi report of the war and a parallel column embodying the Communist report, you are likely to read one and neglect the other. You are also inclined to believe that one is false and the other is nearer the truth. It is well, in such a case, to ask yourself what your prejudices are and why you favor one side more than the other. If you know your bias, you can make some allowance for it. It is equally important to recognize the source of your information. At the time this is being written, Moscow has for several days reported holding the enemy, but details of the fighting indicate an advance of over a hundred miles. Evidently, *holding* here means slowing the advance of the enemy. Likewise, we read that the *Luftwaffe* "bombed" London and that the RAF "blasted" the Ruhr area. Advertisements are full of similar misleading words and phrases. A tonic is "guaranteed to remove dandruff." The reader assumes that it is a permanent cure.

4. *Maintain a critical attitude.* Too often, the student is inclined to lean upon the word of the instructor or upon what he has read. He wants a final summarizing statement from the instructor that he can memorize. The arguments don't matter; he more readily accepts the printed word. "The book says so" makes it final. People are generally disturbed when they find that all they read is not to be accepted as the whole truth. One way of protecting one's equanimity is to disregard conflicting statements. The contradictions are never considered. We say of such a person: "He keeps his facts in logictight compartments." This is not always possible and

never desirable. In a discussion of politico-economic questions, a man whose reading had been limited to a narrow view of the problems was confronted with the facts from other angles. He took these other data to mean that, if the new material was true, what he had read might not be true. "That's it," he said, "what can one believe?" He expressed his sincerity, but he also indicated that he did not realize that he could pick out the relevant facts and reach his own tentative conclusion.

5. *No judgment should be considered final.* Another difficulty our friend failed to realize is that most of our thinking is dealing with situations that do not permit simple solutions or final answers. The scientist makes it a fundamental principle of his work that "this must be accepted as true until new data reveal new revisions." In a conversation with Professor Titchener, one of the leading psychologists at the beginning of the century, it was pointed out that he was contradicting something he had published. "But," he replied, "that was written a year ago." We have to make decisions and act as if our decisions are final, but we should still be willing to accept them as beliefs needing constant revision.

6. *Tolerance.* The above suggestions make it clear that the clear thinker will be tolerant of the opinions of others, at least in his own field of specialization, provided they present facts to justify their own conclusions. You are a patriotic American, for example. If your position is justified on the basis of clear consideration of all the data, then you can appreciate the motives and actions of the patriot of another country. If your patriotism is based upon prejudices and misconceptions, you are likely to assume a naïve attitude of superiority that is unwarranted. The same tolerance should be practiced by student and instructor in the classroom when contradictory opinions are well founded.

7. *Dependence upon authorities.* We are not always able to get the facts. In such cases, we have to depend upon the conclusions of those to whom the facts are available. It is necessary, therefore, to ask: "Is this person capable of dealing with the facts and drawing proper conclusions? Is he free

and unbiased?" If you read an article on finance, our military preparedness, or the labor unions, it is well to inquire who the author is. Is he equipped to write on such a subject?

8. *Doubt and disbelief.* To be critical is to search for the truth. Doubt is the attitude of suspended judgment. It is not a happy state. Hence, we too often switch to the other extreme, from blind faith to disbelief. "I won't believe anything I read." This is the lazy way out. Maintain your inquiring attitude; analyze the material at hand. You will learn to perceive facts and relations of facts.

9. *Learn to apply your knowledge.* One noon, at the lunch table, a professor of engineering complained that a certain group of students was inferior. The discussion revealed that, although these students had had two years more of mathematics than the others, they had no training in the application of their mathematics to engineering problems. Ability to reason is not a heaven-sent endowment. It requires training and hard work on the part of the would-be thinker. You will learn to think clearly, to organize data, and solve problems according to the investment of intelligent application you are willing to make.

17

Levels of Attainment

Measurements of Ability

When we discuss thinking and problem solving, it is almost impossible to avoid reference to a very important aspect of adjustment to new situations. We cannot help but notice both the adequacy of the adjustment and the speed with which it takes place. It is very common for us to speak of those adjustments that are both adequate and prompt as "intelligent" behavior. INTELLIGENCE, THUS, BECOMES A MATTER OF THE SPEED AND ADEQUACY OF ADJUSTMENT TO NEW SITUATIONS. It is not uncommon in our everyday use of the word, however, to fail to remember that, here again, all judgments regarding intelligence must be based upon something that the individual *does* or *says*. It is hoped that, by now, you have discarded any notions that you might have had to the effect that a person's intelligence can be estimated from his appearance, or something about the look in his face, or some other gross physical characteristic.

But we do base our estimates of intelligence upon what the individual does or says. It not infrequently happens that even these estimates are in error. So often does this occur that many psychologists have devoted a great amount of time attempting to discover ways that might be used to increase the accuracy of our estimates. Perhaps it will be well for us to examine the methods that we are using, because the results that have been produced have been enormously encouraging and deserve our careful attention. Another reason for a closer

examination of these methods is that they form the basis of nearly all testing procedures. No one will question the fact that, while modern psychological tests have some drawbacks and disadvantages, many things have been accomplished through their use that would have been impossible otherwise. You will find that, regardless of what it is that is being tested by these devices, the following steps are conventional in the *standardization* of tests.

Analysis

Before any attempt at measurement can be made, there must be some agreement as to what it is that is to be measured. The answer to this question is most directly obtained by a careful analysis of the performance upon which judgments are to be based. What does a person *do* (or *say*) for you to judge him as intelligent? What does a person *do* for you to say that he is a good musician, machinist, chauffeur, husband, clerk, teacher? As we have said time and time again, the answers to these questions are always based upon bits of behavior. The same is true of our judgments of intelligence. Unless we can agree as to what it is that an intelligent person does that an unintelligent person does not do or cannot do, there is no hope for success in our attempts to measure intelligence.

Of course, in the case of intelligence, it may not be possible for us to list all of the things that an intelligent person can do. Such a list would be too long to be practicable. It might be more feasible for us to select a specific circumstance, and then to agree on what an intelligent person would do in that particular situation. This is the procedure that is usually resorted to. In order to get the most complete picture, we would select a wide variety of different instances to examine. We would require each situation to demand something different of the individual, in the hope that the total picture to be obtained would be as representative as possible.

Construction of items

Our next step would be the preparation of those situations into which we propose to place an individual in order to

observe whatever he does or says. In the case of very young children, illiterates, or those who cannot understand our language, these situations might be actual "life-sized" problem conditions, which would require them to go through some sequence of acts that we could witness. Usually, however, we can resort to some form of question-and-answer procedure, performed either orally or by the use of a pencil-and-paper test. A very good illustration of this step is furnished by an examination of a test devised for this purpose, namely, the Army Alpha.

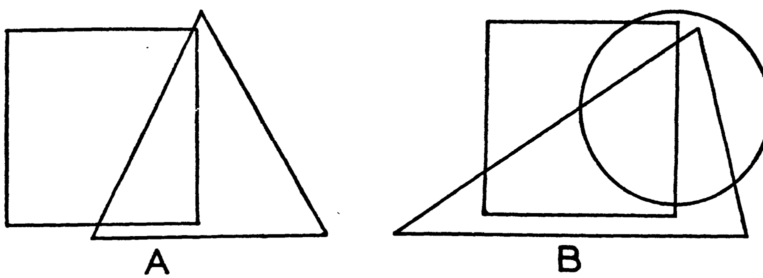

FIGURE 92.—TWO FIGURES USED IN SUBTEST 1, ITEMS 3 AND 4, OF THE ARMY ALPHA TESTS.

Army Alpha. Group tests were devised during the First World War for the purposes of classification and selection of officers. Nearly 2,000,000 men were tested by the means we have described. These tests, generally known as the *Army Alpha,* were divided into eight parts, or tests.

Test 1 required the subjects to follow certain specific directions as these were read by the examiner, such as Item 3: "Write the number *1* so that it will be in both the square and the triangle." Item 4 required the subject to "write a *1* which will be in the circle but not in the square or triangle, and a *2* which will be in the circle and triangle but not in the square" (Figure 92 A and B).

Test 2 involved the solution of arithmetical problems in which the important factor was not so much the arithmetical computation as it was reasoning ability. The first problems are easy, and the rest grow progressively difficult.

Test 3 was a test of *common sense,* and was of the multiple-choice type. For example:

1. If plants are dying for lack of rain, you should:
   a. ( ) water them.
   b. ( ) ask a florist's advice.
   c. ( ) put fertilizer around them.
2. A house is better than a tent because:
   a. ( ) it costs more.
   b. ( ) it is more comfortable.
   c. ( ) it is made of wood.
3. Why does it pay to get a good education? Because:
   a. ( ) it makes a man more useful and happy.
   b. ( ) it makes work for teachers.
   c. ( ) it makes demand for buildings for schools and colleges.

Test 4 was a *same-and-opposite test.* The subject was to underline *same* or *opposite,* corresponding to each pair of terms given. For example:

1. cold—hot	*same*	*opposite*
2. long—short	*same*	*opposite*
3. bare—naked	*same*	*opposite*
4. joy—happiness	*same*	*opposite*
5. find—lose	*same*	*opposite*

Test 5 was made up of sentences with words disarranged. The subject was to rearrange the words to make a sentence, and to decide whether the statement is true or false. For example:

1. cows milk give	*true*	*false*
2. write are with to pencils	*true*	*false*
3. are and apples long thin	*true*	*false*
4. east the in rises sun the	*true*	*false*
5. months warmest are summer the	*true*	*false*

Test 8 was a general-information test in which four answers were given to each statement and the subject was to underline the correct answer, as follows:

1. Maize is a kind of: corn, hay, oats, rice.
2. Nabisco is a: patent medicine, disinfectant, food product, toothpaste.

3. Velvet Joe appears in advertisements of: tooth powder, dry goods, tobacco, soap.
4. Cypress is a kind of: machine, food, tree, fabric.
5. Bombay is a city in: China, Egypt, India, Japan.

A time limit was set for each test, and the number of items was chosen to make it possible for only a very few subjects to answer all of them in the time allowed. The tests, therefore, involved general information, reasoning ability, ability to follow directions, and speed of performance. The results are illustrated in the distribution curves in Figure 93. It will be

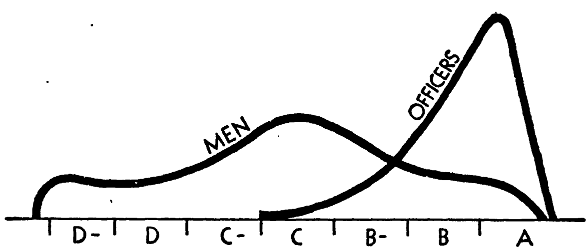

FIGURE 93.—DISTRIBUTION OF RATINGS OF 82,936 LITERATE ENLISTED MEN AND 8,819 COMMISSIONED OFFICERS.

seen that most officers scored higher than most men in the ranks, although some officers scored below the median for a common soldier and a few soldiers scored as high as the highest score made by any officer.

Importance of variety of items

As one reads for the first time the items included in such tests as the Army Alpha, he may be inclined to object that the items are unfair and in many instances absurd. Why should one be judged unintelligent because he does not know that *spruce* is a tree and *Nabisco* is not a fruit? It does not seem important that he should know anything about Velvet Joe or John Wesley or the White Sox. It is true that a test would be unfair or inadequate if it contained only a few items, and all were of this sort. But group tests are made up of a very large number of items from a variety of fields, all of which are fairly well represented in the environment of the majority of individuals. Therefore, we might say that the individual who

can mark the greatest number of items correctly is more alert to his surroundings or more enthusiastic in learning everything with which he comes in contact. On this basis the apparent absurdity disappears when one considers the test as a whole.

It is often objected that the individual could answer the items correctly if he were given more time. It is pointed out that some individuals read and think more slowly than others. However, speed is one of the important factors in everyday life. The individual who can think or act quickly is superior in that respect to the individual who is slow. It is also found that the slow individual, if given more time, does not perform so much better relatively as might be expected. When two forms of the same test were given to the same group of individuals, more time being allowed in one case, it was found that the same general order of rank was maintained: those who had done the best with the limited time allowed also ranked at the top when more time was allowed.

Validity

After the items have been constructed and assembled into a test, the test is then administered to a fairly large group of individuals known to possess to some degree whatever it is we are testing and chosen at random from the population they represent. This is an important step. We must give our test to individuals who possess the trait or ability or skill we are measuring in as wide a range as possible. It will not be enough for us to learn that intelligent people can get high scores on our "intelligence" test. We must also learn what kind of scores are obtained by those of low intelligence and those of mediocre intelligence. This step is sometimes not taken as seriously as it should be. All too frequently, we would be inclined to give a proposed intelligence test only to intelligent people, and be satisfied if they receive high scores on the test. The other side of the picture is sometimes completely forgotten. Not only would it be necessary for people of high intelligence to get high scores on the test, but people of low intelligence must get low scores and people of intermediate intelligence must receive scores somewhere in between these two extremes.

The scatter plot. In order to obtain some notion of the degree to which our proposed test is succeeding in telling the difference between people of high and low ability, we should adopt some scheme that will show the relationship with some *criterion* of ability, such as grades in a college course. One of the simplest means of showing this relationship is the *scatter plot.* Figure 94 illustrates this technique. In this case, at the beginning of the term 115 students were given an

Grades in Course		Test Score 40	50	60	70	80	90	100	110	120	130	Total
	A									//	/	3
	B			/		////	𝍸	////	𝍸 /	𝍸		25
	C		/	//	////	𝍸 𝍸 /	𝍸 𝍸 //	𝍸 𝍸 /	𝍸	/		47
	D		////	////	𝍸 /	𝍸 𝍸	𝍸 /	////	/			35
	E	/	///	/								5
	Total	1	8	8	10	25	23	19	12	8	1	115

FIGURE 94. A SCATTER PLOT OF GRADES IN A COURSE AND SCORES ON A PREDICTIVE TEST.

"intelligence" or "scholastic-aptitude" test, whichever you choose to name it. The scores on this test are given in units of 10 at the top of the chart. The grades received in the course are given in the left column. Then a tally mark is placed for each student in the square that represents both his grade in the course and the score originally made on the test.

By inspection of this scatter plot we can observe that, in this particular instance, there is some relation between the test scores and the grades made in the course that we have chosen as the criterion of the predictive value of one test. There is a trend for students who stand high in the test to stand high in the course, although we cannot say that this is universally true. For example, one student's score was 110 to 119, but he got only "D" in the course. Another was in the 60's on

the test, yet he made a "B" in the course. If there were a perfect correlation between the test and the criterion, the tallies would fall in a straight line from the lower left square to the upper right square.

The coefficient of correlation. While the scatter plot gives us some notion of the relationship between two variables, it is only an approximation. It enables us to say that there is little or no relationship, that there is a fair degree of relationship, or that the relationship is very close. For more exact measurement, we must resort to statistical computations. For this purpose we use some formula that has been derived for the purpose. One such formula is:

$$\rho = 1 - \frac{6 \Sigma d^2}{N(N^2-1)},$$

in which ρ represents the coefficient of correlation by the method of rank differences; d, the difference in rank between the two variables of each subject; Σ, the sum; and N, the number of cases. This is a satisfactory formula when there are fewer than forty cases to be correlated. With larger numbers it becomes too cumbersome, so that we resort to another formula:

$$r = \frac{\Sigma xy}{N\sigma_x \sigma_y},$$

in which x is the deviation from the mean of one variable and y is the deviation from the mean of the other variable. σ_x and σ_y are the standard deviations of the two series, respectively, obtained by squaring each d and then calculating the mean of the d^2 values and extracting the square root of this mean.

Interpretation of coefficients of correlation

One of the uses of the coefficient of correlation is to indicate degree of association, relationship, or concurrence in nature. IT TELLS US NOTHING ABOUT THE KIND OF RELATIONSHIP THAT MAY EXIST, BUT ONLY THAT A RELATIONSHIP DOES EXIST. Here is another temptation that is difficult to avoid, namely, that of

ascribing the relationship of cause and effect to all variables that are correlated. Now, it may happen that one of the variables does cause the other; but such information would necessarily have to come from information other than the mere size of the coefficient. The relationship might simply be a temporal one—that is, one of the variables usually follows the other without there being any connection between them. The relationship might be that of a common cause such that a third factor, not included in the calculations, is responsible for both of the variables that are included. Or, there may be no conceivable relationship at all between the variables. It may "just happen" that the two occur together in nature to the extent indicated by the size of the coefficient. Always remember this when you are required to interpret a coefficient of correlation. You will avoid blunders if you remember that it shows simply the direction and degree of the association, but nothing as to what kind of an association it is.

Another use for the coefficient of correlation is that of predicting one variable in terms of the other. This is the use most frequently made of it. If we know that two variables are associated, we may be able to make fairly accurate predictions of what one will be if we know only the other one. If we have a good test of college ability, for instance, which we know to be highly related to success in college, we are able to predict probable success in college on the basis of the score on the test alone.

Again, mathematical calculations will tell us. Prediction formulas indicate how many individuals may be expected to fall within any specified group in scholastic standing and what the corresponding group in the psychological test is. Table XXIII shows the prediction value of various degrees of correlation when the criterion is divided into ten, five, or three grades. As psychological tests usually correlate about .60 with academic success, and as scholarship grades usually range in five grades, from *A* to *E*, we can see that a student making an *A*-grade standing on the test has thirty-eight chances in a hundred of an *A* rating in college, as is shown in the third column.

Table XXIV gives a more comprehensive arrangement of

the possibilities. If we divide the students into ten groups, according to test performance, and do likewise for scholarship attainment, we see what variations are to be expected when

TABLE XXIII

PREDICTION VALUE OF VARIOUS DEGREES OF CORRELATION

Showing for various degrees of correlation and coarseness of criterion scale the number of individuals actually falling within half a point of where predicted. Theoretically perfect distributions are assumed. (After Hull.[1])

r	Coarseness of Criterion Scale		
	10 points	*5 points*	*3 points*
.00	16%	31%	50%
.40	17	34	53
.50	18	35	56
.60	20	38	59
.70	22	42	65
.80	26	50	73
.90	35	64	87
.95	48	80	97

[1] Hull, C. L., *Aptitude Testing* (Yonkers-on-Hudson, New York: World Book Company, 1928), p. 535.

TABLE XXIV

INTERPRETATION OF CORRELATION COEFFICIENT OF $r = .60$
(After Burtt [2])

$r = .60$	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*
I	39	20	14	10	7	4	3	2	1	0
II	20	19	16	13	10	8	6	4	3	1
III	14	16	15	13	12	10	..	6	4	2
IV	10	13	..	13	12	12	10	8	6	3
V	7	10	12	12	13	12	12	10	8	4
VI	4	8	10	12	12	13	12	12	10	7
VII	4	6	8	10	12	12	13	13	13	10
VIII	2	4	6	8	10	12	13	15	16	14
IX	1	3	4	6	14	10	13	16	19	20
X	0	1	2	3	4	7	10	14	20	39

[2] Burtt, H. E., *Principles of Employment Psychology* (New York: Houghton Mifflin Company, 1926), p. 563.

$r = .60$. A student who is in the third group, or decile, on the test has fourteen chances out of a hundred of being in the first decile in scholarship, sixteen chances of being in the second decile, fifteen chances of being in the third, and only two chances

of being in the tenth decile. On the other hand, a student in the ninth decile has only one chance of rating in the first decile on scholarship and twenty chances of being in the lowest decile.

This is about all of the statistics that you need to know in order to comprehend most of the work that is going on now in psychology. If you should pursue the study of psychology further, you may have occasion to become acquainted with more elaborate devices. For the beginner, however, much can be understood with no more background than that indicated in the present chapter.

It can and does sometimes happen that a person's estimate of another person's intelligence is not a very valid thing in and of itself. In such a case, we might prefer to have some other standard or criterion of excellence, something a little more objective. In looking around for other standards, we might agree on some such standard as progress in school or performance that we can measure in some other activity. As a matter of fact, this very same difficulty was encountered in the process of validating the Stanford-Binet test. It was found that, when performance in the test was correlated with the teacher's estimate of intelligence, the correlations were discouragingly low. A careful examination of the situation revealed, however, that teachers were given to making some rather constant errors in their own estimates. It was not unusual, for instance, for a teacher to overestimate the intelligence of a talkative child and underestimate that of a quiet child. She would also tend to overestimate the intelligence of the older children in her room and underestimate that of the younger. And so it was decided to use grade placement as the criterion against which score on the test would be compared. Grade placement was thought to be a more valid measure of ability, because it was not so likely to be subject to the whims of one teacher; it was, actually, a reflection of the estimates of several teachers. When performance in the Binet tests was correlated with grade location, the coefficients were raised from about .50 to about .80. By the use of these tests, therefore, it was possible to predict rather accurately where a child should be in school. While the predictions were not one hundred per cent accurate,

they were vastly superior to the older methods of relying solely upon some person's judgment.

Of course, no one likes to be accused of not being a pretty good judge of the intelligence of his fellow man. When it was discovered that these intuitional judgments were not confirmed by the more rigorous testing devices, it was maintained by many that the tests were not really tests of intelligence after all. You will find many people today who are quite impatient with the tests, and would like to believe that they really do not measure a thing. If you look behind the reasons these people give, you may be surprised to find that they have, at some time or other, had an unfortunate encounter with one of these tests. Perhaps they took one and were judged to be "below average." Very few people will admit that such is true in their own case. Perhaps they took such a test, and their poor performance prevented their being admitted to school or kept them from obtaining a particular job. People do not readily admit that these are their reasons for disliking a certain test, but that such reasons do play a large role in determining what people will think cannot be doubted.

Psychologists themselves have sometimes become engaged in debate on the matter of just what it is that the tests measure. The argument is a most futile one, especially when one thinks of the more useful things that the time and energy spent in argument could be put to. As a result, many psychologists simply refuse to argue the point, and let the tests stand or fall on a basis of what the tests can do. If they make predictions that are more accurate than guesswork or human intuition, then by all means use them, regardless of what it is they measure. As a result of this fortunate attitude, there are almost no tests that are called *intelligence tests.* Once in a while, you will hear a test called by the vague title of *psychological examination* or *test of mental ability,* but if someone would suggest changing the name, there would be no objection. The usefulness of the test would not be affected one way or the other by its name. It is common practice nowadays to name a test in accordance with whatever standard or criterion it correlates most highly with. Thus, if a test correlates most

highly with grade placement, it may be called a *test of school ability;* if it correlates rather well with performance in college, it would be called a *college-ability test;* if it should correlate with performance in a machine shop, it would be called a *mechanical-ability test;* and so on. One well-known test of *mechanical ability,* so called, actually has a higher validity with clerical ability should therefore be called a clerical-ability test. The name of a particular test should tell us the performance to which it is most closely related, and perhaps nothing of what the test actually measures.

Reliability

Another step in the standardization of tests is a determination of the consistency with which a test measures whatever it is intended to measure. THE DEGREE OF INTERNAL CONSISTENCY OF A TEST IS INDICATED BY THE "COEFFICIENT OF RELIABILITY." The *coefficient of reliability* is a correlation in which the two variables are directly concerned with the test itself, and not with an outside standard. The reliability of a test may be determined by any of the following methods:

1. *The retest method.* The simplest method of determining reliability is that of giving the test again to the same group of individuals at a later time. Of course, the scores for the second administration would be a little higher, but relative positions of each individual should not be seriously affected if the test is a reliable one. This method is called the *retest method* of determining reliability. It is a step taken to assure us that the results of the first test were not a matter of chance; that individuals who score high at one time will also score near the top at another time.

2. *The split-half method.* Another method of determining reliability to be used when the group is not available for a second test is the so-called *split-half method.* This method divides the test into two tests by giving each individual a score on the number of even-numbered items that he answered correctly and another score on the number of odd-numbered items This method assumes that the test is really made up of two tests, and that both tests were given at the same time. An-

other name for this method is the *odd-even method* of determining reliability.

3. *The equivalent-form method.* Still a third method makes use of different forms of a test that are of equal difficulty. This is the *equivalent-form method,* and is not as widely used as the other two. In order to carry it out, twice the number of items are necessary as would be required by either of the other two methods. There is the additional disadvantage of the doubt that the two forms may not be of equal difficulty, although this is not a serious drawback.

Whenever a test is correlated with itself by any of these methods of determining reliability, we are concerning ourselves only with factors relating to the test itself. We are not at all interested in what the test may be measuring. The two variables that we would be correlating, therefore, would be two sets of scores in the same test. These two sets of scores would be obtained by any of the methods listed above. In order for a test to be useful for measurement or predictive purposes, its reliability must satisfy certain minimal requirements. If the test is to be used in the guidance or comparison of individuals, it must have a reliability of not less than .80. Most psychological tests have reliabilities much higher than this. If the test is to be used only in making group comparisons, the reliability may be as low as that indicated by a coefficient of .40. We run considerable risk whenever we use for individual comparisons a test that was designed for and satisfies only the requirement for group comparisons. The severity of these standards that the psychologist has placed upon his measuring devices may be realized when it is pointed out that the basal-metabolism test used rather widely by doctors for individual diagnosis has a reliability of only about .35.

Norms

Once the test has been validated and its reliability has been determined, the matter of interpreting the score is the next concern. As we have already demonstrated, a raw score of total number correct or total number of errors is valueless.

Certainly for guidance purposes, it is essential to have some notion regarding the relationship of an individual's performance to the performance of others on the same test. Furthermore, it would be helpful to compare the score, not with those obtained from a sampling of the entire population, but more specifically with those scores made by people who are very much like him in other ways, or by people with whom he is to compete for jobs, or by people who are already successful in occupations that have been selected by him as his future lifework. For this reason, all of those individuals who have ever taken a given test are broken down into various subgroups, according to whatever aspects of the general population we may be interested in.

DISTRIBUTIONS OF SCORES ARE THEN MADE FOR EACH OF THESE SUBGROUPS. THESE DISTRIBUTIONS ARE CALLED "NORMS." Thus, we may have age norms, sex norms, occupation norms, education norms, or any other subgroup division that may concern us. Now, if we are especially interested in the score made by a thirteen-year-old girl on a particular test, it would be nonsense to compare her score with those made by fifteen-year-old girls or by ten-year-old girls. It would also be useless to compare her score with those made by boys. What we would want would be a distribution of scores made by thirteen-year-old girls, preferably in the same general socioeconomic status and in other essential ways like the girl whose score is of particular interest to us. And so we would be rather careful in our selection of the particular norm group to be used.

Of course, each norm group would vary from every other one in some important respects. The mean scores for each group would be different; the standard deviations would be different. Each time we converted a raw score into a standard score or a centile rank, it would be in terms of the characteristics of the particular norm group that we are using for comparison purposes. Thus, if you had received a raw score of 174 on a college-ability test, your centile rank might conceivably be 93 if we used the norms for graduating high-school seniors, 84 if we used norms for freshmen in colleges everywhere, and

86 if we used norms for the freshmen in the college you are attending. The same would also have been true if we had used the standard deviation (σ) instead of the centile rank. See Figure 100.

We have gone to some pains to discuss these steps in the standardization of a test. Our purpose has been to show the procedure required in the setting up of an accurate measuring device. Unless this plan is followed rather carefully, we have no assurance that the device is anything more than the product of someone's imagination. There are plenty of the latter type of "test" being used on an unsuspecting public. When you encounter a new test, you have every right to ask: "How was it validated? Is it reliable? What norm groups is my score to be compared with?"

The distribution of I.Q.'s

While we frequently hear people adjudged "bright" or "stupid" by their fellows, the common notion still persists that

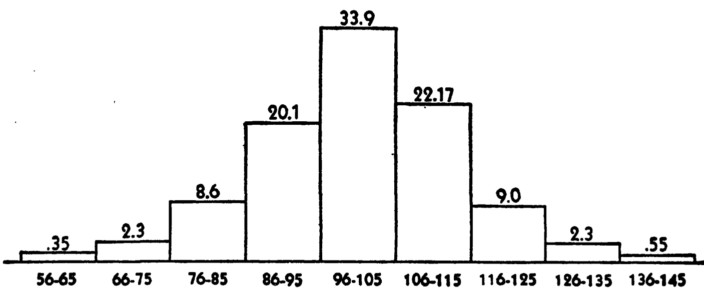

FIGURE 95.—DISTRIBUTION OF I.Q.'S OF 905 UNSELECTED CHILDREN 5 TO 14 YEARS OF AGE. (*Terman.*)

the native endowment of most of us is just about the same. If one is less alert than another, or if he is slow in catching on, that is his own fault. If he lags behind in the economic struggle, either he is lazy or luck has been against him. Beyond this group of normal people, it is recognized that a few may be geniuses and a few may be feeble-minded. A glance at Figure 95 will show that this is not true. The I.Q., we have

seen, expresses the relation between a child's ability on the test and what should be expected at that age. If we classify the results for a large group of children, as was done to construct this curve, we at once see that a large percentage follows the normal I.Q. of approximately 100; and that, if the I.Q. increases or decreases, the number becomes progressively smaller, until relatively few individuals are discovered at the extremes.

One point, however, should be noted: It will be recalled that each test was selected because, at a given age, half of the children could pass it; and because progressively fewer at lower age levels could pass it, while fewer failed it if the age increased. The assumption of the investigators who constructed these tests was that there is a variation in ability and that this variation conforms to the normal distribution curve. Hence, the tests were so constructed that they would display this normal distribution. It is possible that a test could be constructed that would be represented by another curve. However, the ideal of any test is to differentiate as accurately as possible between individuals, and it is therefore quite probable that the curve most nearly represents the distribution of the attainment of school children under normal environmental conditions.

Recognition of ability

One reason why there has been confusion in differentiating between levels of ability has been that there have been no adequate definitions for making such a distinction. If an individual is unusually bright, he can be recognized as a *genius* or *superior person*. On the other hand, if he is dull or extremely unintelligent, we can call him *feeble-minded*. Between the feeble-minded and the genius the terms ordinarily used are inadequate. By basing the definitions upon the I.Q., it is possible to give a more distinct classification of the terms in ordinary use. Table XXV gives the classification and definition of terms in I.Q. units that are most frequently used.

The results of these tests are also used to distinguish between an individual's ability and what he actually accomplishes in

everyday life. Very frequently, an individual is accused of being lazy because he fails to get his work done, or a boy is considered naughty because he raises a disturbance in school. That our judgment is in error may be illustrated by the following two cases:

1. A boy in high school was transferred to a new teacher, accompanied by the information that he was one of the bad boys of the school. Soon after his arrival, there was considerable disturbance in his part of the room. It all centered around this boy. One day, the teacher called the boy to his desk and showed him a problem in algebra that he himself had been unable to solve, asking him if he thought he could solve it. For several days, all was quiet, and then the boy presented his solution. Soon the disturbance was again noted, but the teacher took his cue from his first experience, and thereafter managed to have something on hand to keep the boy busy. It turned out later that this boy possessed an I.Q. of somewhat over 140—in other words, an attainment reached by only about five per cent of the entire school population.

TABLE XXV

Definition of Intelligence Levels in Terms of I.Q.

I.Q.	*Classification*
Above 140	Near genius or genius
120–140	Very superior
110–119	Superior
90–109	Normal or average
80–89	Dull (rarely classified as feeble-minded)
70–79	Borderline (often classified as feeble-minded)
50–69	Moron (classified as feeble-minded)
20–49	Imbecile (classified as feeble-minded)
0–19	Idiot (classified as feeble-minded)

A boy in the ninth grade was considered lazy by most of his teachers. He looked drowsy most of the time in class. One day, one of the teachers who thought him lazy happened to pass the manual-training room while this boy was busy making a tin cup. At first, he did not recognize the boy. Later, he remarked to the manual-training teacher about this ex-

perience, and the latter said: "Yes, he is a bright boy." This boy had an I.Q. of a little under 80. Both teachers had erred regarding his intelligence. He was not capable of doing the work of the ordinary classroom and therefore *appeared* lazy. He could do such things as were required in the manual-training shop, however; and because he was interested in this kind of work, the teacher of that subject considered him intelligent.

Nonlanguage tests of general ability. Often it is desirable to use a test that does not depend upon the subject's knowledge of language. For example, the Binet tests would be unfair

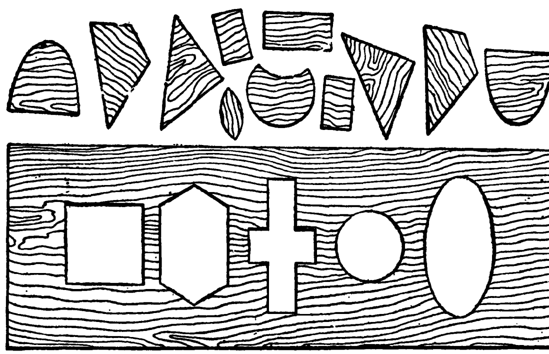

FIGURE 96.—THE FIVE-FIGURE FORM BOARD. (*After Pintner and Paterson.*)

to deaf-mute children and to children who lived in a home where only a foreign language was spoken. For this reason, several nonlanguage tests have been developed. One of these [1] makes use of a series of form boards, one of which is shown in Figure 96. The subject is instructed to fit the pieces into the proper places as rapidly as possible. Both the time required and the number of errors are recorded. Placing a piece in the wrong position is considered an error. These tests were first given to an unselected group of school children at different ages, in order to establish norms. Figure 97 illustrates the norms for the five-figure form board for a group of children ranging in age from four to fifteen years. The heavy line represents the

[1] Pintner, R., and Paterson, D. G., *A Scale of Performance Tests* (New York: D. Appleton-Century Company, 1917).

median time in seconds; the upper and lower finer lines represent the twenty-five and seventy-five centiles (lower and upper quartiles), respectively. If we regard the median at each age as the standard of performance for the normal child, this test might differentiate performance levels at the lower ages fairly well; but at nine years and older, the differences are relatively slight. We also see that there is a wide distribution at each age, particularly in the earlier years, as is indicated by the interquartile ranges.

It may be argued that these are tests of mechanical aptitude,

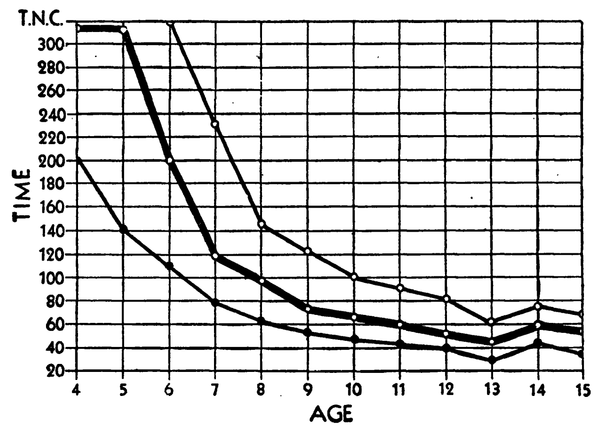

FIGURE 97.—NORMS IN SECONDS FOR THE FIVE-FIGURE FORM BOARD. (*Pintner and Paterson.*)

but that they do not measure intelligence. The soundness of your criticism will depend upon what you mean by *intelligence.* If you mean that intelligence must be verbal, then your criticism is correct. If you are willing to agree that intelligence is expressed in ability to perceive relations of size and shape, the relation of a part of a picture to the whole and to a sequence, the ability to understand directions and to act accordingly, then such tests as these measure a part of intelligence, if not all of it. All so-called "intelligence tests" are based on the assumption that intelligence is measurable in terms of what the individual has learned in a normal environment. They are measures of *levels of attainment* through maturation and learning.

Intelligence of Groups

Race differences

The value of verbal and performance tests is well illustrated by the attempts to determine possible differences in intelligence of various groups. We would like to know whether the American Negro possesses ability that is equal or inferior to that of the white population. The first step is to select two groups that have had equal social, economic, and educational opportunities. This is practically impossible. The Negro's economic status may be the same as a white man's, but the whole social fabric, and hence the educational opportunities, are different. Our tests therefore measure, not native abilities, but the effects of two very different environments.

Studies of this kind have shown that the *mean* I.Q. of the Negro is lower than the mean for whites of the same socioeconomic status. But the overlapping is very great. Some Negro children possess an I.Q. of 140 or more, while some white children are feeble-minded. These are the exceptional cases in both groups. What we would like to know is how much of the difference in I.Q. standing of the two groups as a whole is due to native endowment and how much is due to social factors that have not, or cannot, be controlled by the investigations.

The difficulty of equating groups was met in one investigation by using Indian children of different degrees of white blood.[2] These children all came from the reservations in the Middle West and, at the time, were living in the same institute. Therefore, they may be considered a relatively homogeneous group so far as the social environment is concerned. The test used differed from the types thus far described in that it was entirely a paper-and-pencil test and could be administered to a group at one time.

The median score for these children was 83, while the score for white children of the same ages taking this test was 123. This difference may be attributed to the superior opportunities

[2] Hunter, W. S., "The Relation of Degree of Indian Blood to the Score on the Otis Intelligence Test," *Journal of Comparative Psychology* (1922), p. 257.

of the white children. However, when the Indians were classified according to the proportion of Indian and white ancestry, it was found that a definite relationship existed between the scores and whether they were quarter-, half-, three-quarter-, or full-blood Indians. It should be remembered that the *norm* is an average score for a given age group. Many children deviated above or below the average, of course, but there would be approximately fifty per cent on either side. When we turn

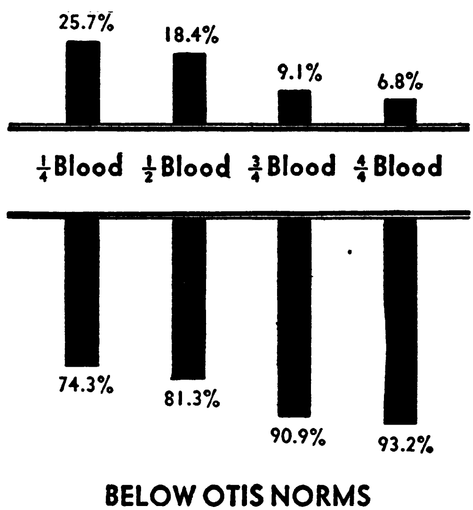

FIGURE 98.—PER CENTS OF INDIANS TESTING AT OR ABOVE AND BELOW OTIS NORMS. (*Hunter.*)

to the distribution of the scores of the Indian children, however, as shown in Figure 98, we find that only 25.7 per cent of the quarter-bloods scored above the norms for white children, while 74.3 per cent scored below these norms. There is a progressive shift downward of the scores as the degree of Indian relationship increases. We may conclude, therefore, that the Indian living under environmental conditions equal to those of the whites would be inferior in performance *as measured by this particular test of intelligence.*

We frequently speak of *races* when we are considering nationalities. For example, we hear a great deal of late about the German as a "Nordic." Anthropologists have classified

man into races on the basis of certain characteristics, such as the shape of the head and face, color of skin and hair, height, and so forth. There has been such an intermixture of races since man migrated from one continent to another that it is improper to speak of any nation as belonging to one type or race. The Germans and French are predominantly Nordic in the north of Europe, with Alpines becoming more prevalent to the south; while Alpine and Mediterranean types inhabit Italy.

TABLE XXVI

SUMMARY OF RESULTS MADE BY THREE RACIAL GROUPS ON FIVE PERFORMANCE TESTS

	Mean Score	*Median Score*	*Standard Deviation*
Urban:			
Paris	219.0	218.9	46.2
Hamburg	216.4	218.3	45.6
Rome	211.8	213.6	42.6
Rural:			
German Nordic	198.2	197.6	49.0
French Mediterranean	197.4	204.4	45.6
German Alpine	193.6	199.0	48.0
Italian Alpine	188.8	186.3	48.4
French Alpine	180.2	185.3	46.6
French Nordic	178.8	183.3	56.4
Italian Mediterranean	173.0	172.7	54.2

In order to ascertain whether there is any difference in abilities in these types, one investigator[3] selected one hundred twelve-year-old boys in each of seven country districts in France, Germany, and Italy. Each group was composed of one of the three racial types, according to physical measurements. In order to meet the language difficulties, five of the performance tests previously described were selected. In addition to the seven selected rural groups, unselected boys of the same age living in the cities of Paris, Hamburg, and Rome were tested for comparison. Table XXVI summarizes the re-

[3] Klineberg, O., *A Study of Psychological Differences in "Racial" and National Groups in Europe,* Archives of Psychology No. 132 (1931), p. 58.

sults. The difference in scores between the groups was not significant. Furthermore, as can be more easily seen in Figure 99, each group may hold a different relative position in one country from what it holds in another.

The difference between city and rural groups throws some further light on the total performance and emphasizes the difficulty of making such comparisons. It will be seen that the city boys scored higher than the rural boys. The author points out that this difference can be explained in part by the

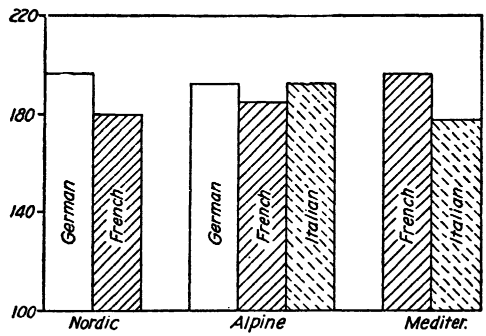

FIGURE 99.—BAR GRAPHS REPRESENTING THE SCORES OF TWELVE-YEAR-OLD BOYS OF THE NORDIC, ALPINE, AND MEDITERRANEAN TYPES.

habits of the two groups. The city boy's life is pitched to a higher tempo. He is accustomed to moving quickly, and these tests were scored in seconds. The city boy is also more accustomed to meeting strangers. Therefore, the proper rapport with the examiner was more satisfactorily attained.

We may conclude from such investigations as these that national and racial groups do not differ in native intelligence. If they do differ, the tests that are now available and the techniques for controlling the variables are inadequate. It is generally believed that the intelligence of the members of ancient civilizations, such as that of the Egyptians and Greeks, was just as great as that of modern man. What has changed is the mode of living, as a result of the accumulation of knowledge and invention. As a man remarked recently: "Think of two planes traveling toward each other at 400 miles an hour! And the pilots have the same reaction time as

Moses." We have no adequate way of knowing what the Indian or the Negro would be like if he had had the same cultural advantages for centuries that the Western European has had.

The significance of a difference. At this point it will be worth while to point out that the difference between two averages is not necessarily very important. Let us suppose that we have given a test to a group of city children and also to a group of rural children of the same age. When we calculate the mean score of each group, we may find that the average score of the city children is higher than that of the country children. Is this difference significant? If the distribution of scores for the two groups should be such as is represented in the graphs of Figure 100 A, it would be clear that the difference is certainly significant.

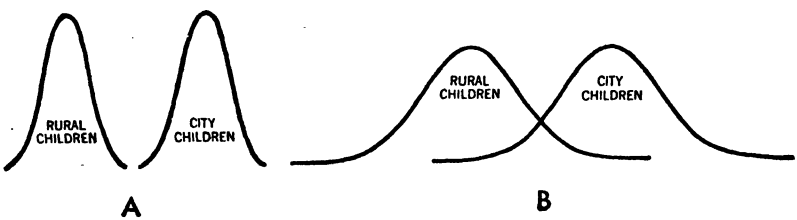

FIGURE 100.—CURVES TO REPRESENT THE IMPORTANCE OF DISTRIBUTIONS WHEN CONSIDERING DIFFERENCES IN AVERAGES.

But what could you conclude if the distributions were represented by B of this figure? Obviously, there is considerable overlapping. This is very frequently the case. We are inclined to note the difference between two averages and to neglect the overlapping of the two sets of data.

To determine the significance of the difference, we might again have recourse to statistical procedures. It will be sufficient for our purposes, however, if you remember to ask, whenever a difference in two averages is given: "To what extent do the individual data overlap?" A simple way to state the fact would be to say: THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN ANY TWO SETS OF DATA IS DETERMINED VERY LARGELY BY THE VARIABILITY OF THE MEASURES ABOUT THEIR CENTRAL TENDENCY, OR AVERAGE.

Nationality and test scores

It would also be interesting to know whether peoples of different countries and races possess different degrees of natural ability. The soldiers were classified according to their national origin, and the average scores of the various groups were classified. The results are shown in Table XXVII. It will be observed that the men from northern Europe are generally superior to those from southern Europe. Here, again, it is problematical whether these differences are due to similarities and differences in language or to the social status of the different groups. In other words, if those coming to this country from Italy are of an inferior class socially, their opportunity of development might be markedly inferior to that of those coming from the more favored groups.

TABLE XXVII

DISTRIBUTION OF ARMY ALPHA SCORES OF GROUPS OF DIFFERENT NATIONAL ORIGINS

National Origin	*Per Cent in Class* A *or* B	*Per Cent in Class* D, D–, *or* E
England	19.7	8.7
Scotland	13.0	13.6
White draft	12.1	24.1
Holland	10.7	9.2
Canada	10.5	19.5
Germany	8.3	15.0
Denmark	5.4	13.4
Sweden	4.3	19.4
Norway	4.1	25.6
Ireland	4.1	39.4
All foreign countries	4.0	45.6
Turkey	3.4	42.0
Austria	3.4	37.5
Russia	2.7	60.4
Greece	2.1	43.6
Italy	0.8	63.4
Belgium	0.8	24.0
Poland	0.5	69.9

Occupation and test scores

One of the questions that arises in connection with such tests is whether the performance of one occupational group

will be superior to that of another. The distribution of scores in the Army (Figure 93) clearly indicates that the majority of the commissioned officers scored higher than the average of the soldiers. Table XXVIII gives the average scores of different occupational groups. The scores are in terms of the number of points made out of a possible 212. The first column gives the first quartile score, or the

TABLE XXVIII

ARMY ALPHA SCORES OF OCCUPATIONAL GROUPS

Occupational Group	*First Quartile*	*Average*	*Third Quartile*	*Per Cent in Class* A *or* B
Engineer officer	144	162	176	96
Medical officer	117	129	152	77
Mechanical draftsman	84	114	139	59
Mechanical engineer	73	110	137	47
Bookkeeper	77	101	127	46
Telegrapher	61	85	110	28
General mechanic	48	68	94	14
Toolroom expert	50	67	92	9
Telephone lineman	43	64	88	12
Bricklayer	37	58	88	11
Barber	34	55	78	7
Teamster	30	50	72	6
Miner	40	49	71	5
Farmer	30	48	73	7
Laborer	28	47	68	4

score that twenty-five per cent failed to pass (25 centile). The second column gives the average, or the score that half of the group failed to pass (50 centile). The third column gives the third quartile, or the score that three fourths of the group failed to pass (75 centile). The Army also employed the letter grades *A, B, C, D,* and *E* to classify the scores. Thus, the general average scores were grade *C*. *B* represented high average, and *A* superior.

The test performance of the engineer officers was superior to that of any group. The general mechanic outranked the bricklayer, while the farmer and common laborer were at the bottom of the list. There are several possible interpretations of these results.

1. These scores indicate that those in a given occupation possess a certain level of attainment that is the result of native equipment.

2. Or, occupations differ in the native ability required; and, through competition, those of lower ability are crowded down into the occupations in which this demand is not so great.

3. Or, the particular demands of this examination are met by one occupational group more completely than by another.

The farmer may possess as great general ability (native equipment) as the bricklayer, but this particular test does not measure his attainments so well. The sampling gives the advantage to the other groups. For example, most bricklayers are city dwellers. They have come in contact with a great variety of individuals, while the farmer has been more confined to the associations of his own family and a few relatively distant neighbors. This does not necessarily mean that the farmer is more ignorant than the bricklayer, because actually from childhood he has been confronted with many things that rarely come to the notice of the city dweller. The seasons, rainfall, drainage, heredity in stock breeding as well as in crops, and numerous skills that are foreign to the city dweller are commonplaces to the farmer.

The tests that we have described do take these differences into account, but the point raised here is that test construction is not so simple as one might at first assume it to be. When you examine the results of a test, you should inquire "what test?" and "for what group or for what purpose was this test designed?"

Special Abilities

Such tests as the Binet intelligence test and the Army Alpha were designed to measure the general ability of the individual. They make no pretense of measuring the ability to do specific tasks, except as these tasks require a certain degree of general intelligence. You would not think of engaging a moron as an accountant or engineer, although he might do very well as a houseboy or unskilled laborer. For special tasks, you

would not be primarily interested in the general intelligence of the worker. You would want to know how well he could do what the job requires. If you were selecting men and women for specific jobs, you would want to know: (1) what the job requires; and (2) what likelihood there is that the applicant can meet these requirements.

One method of dealing with the situation, on the basis of a general knowledge of the task, is to interview the applicant regarding jobs he has held. If it is thought that he may be able to do the job, he is given a trial. If he does not succeed, he is discharged. This is not only an expensive procedure, but creates an unfortunate attitude on the part of the worker.

A more scientific procedure involves the steps discussed at the beginning of this chapter. After a careful analysis of the job, we would construct items that relate rather directly to the job itself. Then the test would be administered to a number of individuals who attained varying degrees of success on the job. The results of the test would be correlated with some outside criterion, such as wages, number of years with the company, opinion of the foreman, or some other measure of excellence. If the validity and reliability of the test satisfied the requirements we have listed, it could be used to select future employees from a list of applicants. On a basis of the test results, we can predict, with a fair degree of accuracy, how well the new employee will do on the job. The savings in energy, time, and disappointment when such a method is used are enormous. Many large manufacturing concerns have used it to great advantage.

Ability profiles

Instead of picking from a list of applicants those best fitted for a specific job, it may be desirable to classify the whole group according to some scheme in order to determine in what job they would be most likely to succeed. The same tests would be given to all applicants. All college students, for example, might be given a variety of tests and then told whether they would do better to go into law, medicine, dentistry, or some other profession. Some progress has already been made in this

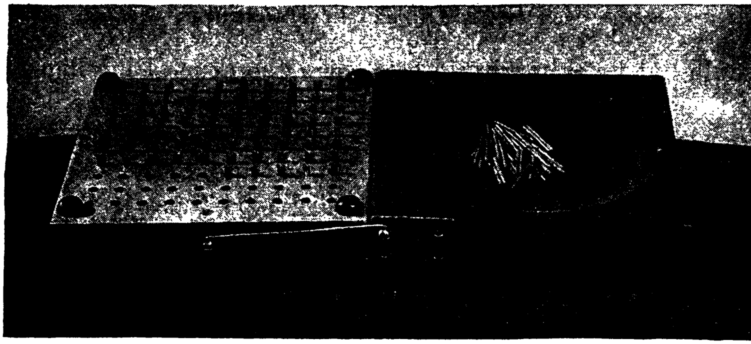

FIGURE 101.—O'CONNOR'S FINGER DEXTERITY TEST.

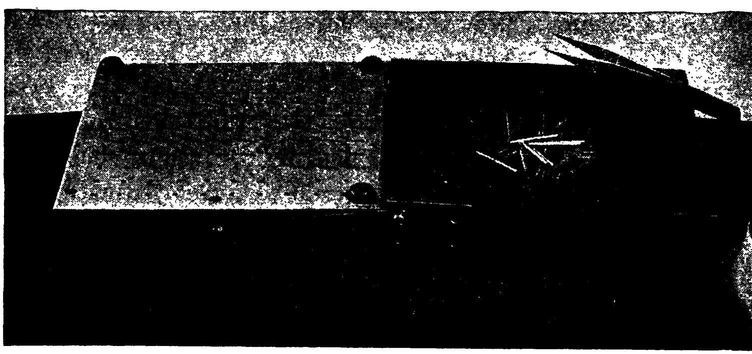

FIGURE 102.—O'CONNOR'S TWEEZER DEXTERITY TEST.

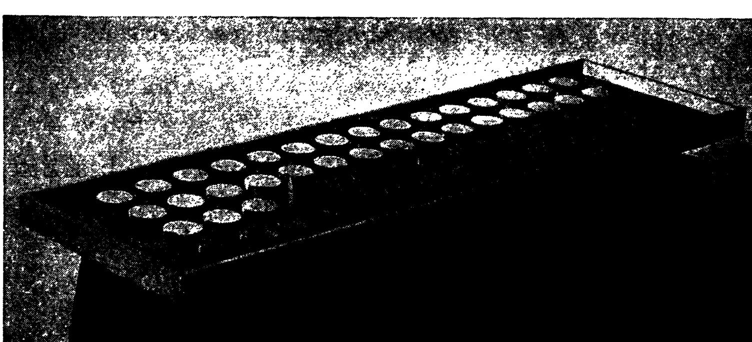

FIGURE 103.—MINNESOTA MANUAL-DEXTERITY TEST. (*From Patterson and Darley, "Men, Women, and Jobs."*)

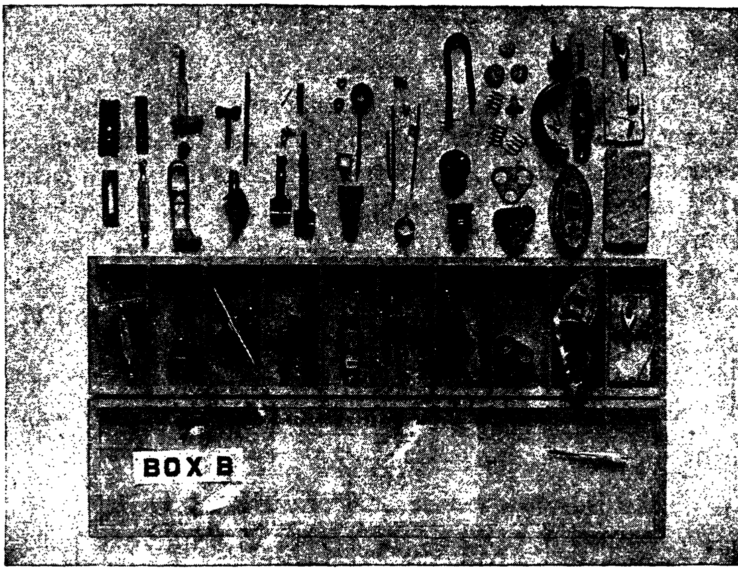

FIGURE 104.—ONE OF THE THREE BOXES CONSTITUTING THE MINNESOTA MECHANICAL-ASSEMBLY TEST.

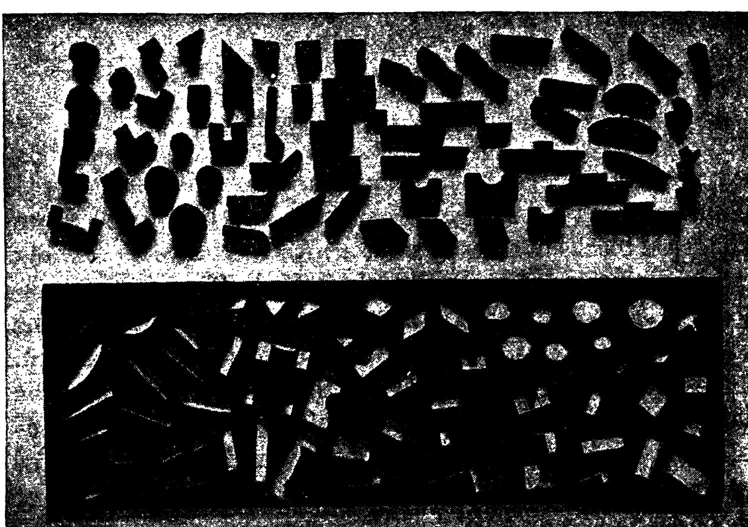

FIGURE 105.—MINNESOTA SPATIAL-RELATIONS TEST BOARD D, ONE OF THE FOUR BOARDS CONSTITUTING THE TEST. (*From Patterson and Darley, "Men, Women, and Jobs."*)

direction, but these higher professions are so complex and involve so many subclassifications that the surface has been scarcely scratched. Such occupations as department-store salesmen, office clerks, and garage mechanics have been easier to classify. In one vocational study,[4] the same tests were given to men office clerks and to garage mechanics. The following tests were used: (1) educational ability, which is virtually a test of general intelligence or learning ability; (2) number checking, a measurement of speed and accuracy in perceiving similarities and differences in numbers; (3) two finger-dexterity tests, which required the subject to place small

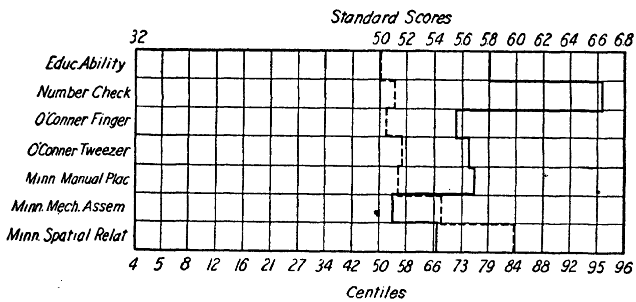

FIGURE 106.—PROFILES OF GARAGE MECHANICS AND MEN OFFICE CLERKS AS THE RESULT OF SEVERAL TYPES OF TESTS. The dotted lines represent the results of the garage mechanics.

pegs in holes, either with the fingers or a pair of tweezers; (4) manual-dexterity test, which required the subject to place cylindrical blocks in holes in a board; (5) mechanical-assembly test, which provided the parts of a variety of mechanical devices—such as a doorbell, linked chain, and so forth—to be assembled by the subject; and (6) a spatial-relations test. These latter two tests differed from the manual-dexterity tests in that they measured the complex abilities required of mechanics, while the performance in the manual-dexterity test was simply a speed test and was not dependent upon judgment of size or shape (Figures 101 to 105).

The results of these tests when applied to a group of garage

[4] Patterson, D. G., and Associates, *Men, Women, and Jobs* (Minneapolis, Minnesota: University of Minnesota Press, 1936), p. 145.

mechanics and to a group of men office clerks are shown in Table XXIX. Figure 106 gives the results in what is termed an *occupational pattern*. The point to be made of these studies is that, for some occupations, relatively high abilities of one kind are required, while other abilities may be low. This is further shown when these tests were given to women department-store clerks and women office clerks. After the profiles had been constructed, judges who were familiar with such patterns for the two groups were able to classify the individual profiles with a high degree of accuracy. Such profiles, therefore, may be used to determine whether an applicant is best fitted for the position of salesman or office clerk, or for anyone of a limited variety of vocations.

Interests as measures of vocational aptitude

In many instances, it is not possible or desirable to set up specific tests of vocational ability, because the occupation is too complex. There are so many ways in which you could succeed or fail in the occupation that it would require too many specific qualities and the construction of too many tests to be practical. Think of all the businessmen you know, or of all the doctors, lawyers, or schoolteachers. Each of these professions can be subdivided into any number of subdivisions. A man succeeds in one of them because he makes the job fit his specific abilities and interests. You probably could do equally well in any profession so far as your special talents are concerned. Mathematics, logic, scientific attitude, and human interest may fit very well in medicine, law, or engineering, for example.

The next step, therefore, is to ask what your interests are. What have your early training and early activities indicated as to what you would be most likely to enjoy as the major activity for the rest of your life? You say that you would like to be a doctor. Why? Because a doctor has prestige; he is looked up to by those in his community. "I would like to alleviate suffering." Good reasons these, as far as they go. But have you shown any indication so far in your life that you are interested in what a doctor does? It is one thing to be a doctor, something else to do what a doctor does. Have you found chemistry and zoology interesting? How have you

reacted when someone was ill or injured in your presence? Perhaps your interest in medicine is based upon your admiration of some doctor that you know, not upon the job of being a doctor.

TABLE XXIX

MEAN SCORE AND STANDARD DEVIATION ON TESTS OF MEN OFFICE CLERKS AND GARAGE MECHANICS

Test	*Office Clerks*	*Garage Mechanics*	*Standard Sample*
Education Ability:			
Pressey Senior Verification			
Number	110	102	423
Mean Score	65.9	44.5	46.9
Standard Deviation	15.0	17.3	20.9
Number Checking:			
Minnesota Clerical			
Number	114	101	491
Mean Score	136.8	85.6	83.1
Standard Deviation	26.0	23.1	29.2
Dexterity:			
O'Connor Finger			
Number	113	102	488
Mean Score	255	278.4	280.2
Standard Deviation	34.8	39.2	51.0
O'Connor Tweezer			
Number	109	102	498
Mean Score	323.1	352.2	360.6
Standard Deviation	47.0	54.4	61.5
Placing:			
Minnesota Manual			
Number	66	102	382
Mean Score	224.0	236.6	240.4
Standard Deviation	18.3	22.1	30.0
Mechanical Ability:			
Mechanical Assembly, Box A			
Number	69	102	494
Mean Score	70.3	74.8	63.1
Standard Deviation	13.6	11.0	19.3
Spatial Relations:			
Minnesota Spatial Relations			
Number	113	102	489
Mean Score	1,148.8	1,014.0	1,262.0
Standard Deviation	252.7	209.9	308.5

One simple method that will help you in choosing a profession can be suggested: Make a list of all of your activities, all the things you have done in recent years. In which of these do you believe you have been most successful? This is a good method of talking to yourself. It is not necessarily accurate, but it will help to clarify your thinking on the subject.

Because we are more inclined to do the things we do well, our interests are a good indication of our abilities. For this reason, psychologists have laid a great deal of stress upon interests in the matter of vocational guidance. First, a survey is made of all the interests, professional and nonprofessional, for the various professional groups. It is found that many of these interests are more frequent among one group than among another. These items are sorted out and combined into a single test. By a rather complicated scoring method, it can be determined whether you conform more to the interests of the lawyer or doctor, or to those of some other profession. Your instructor can furnish you with these tests, which can be sent away to be scored for a small fee.[5]

A similar attempt to determine profiles for more complex vocations has been made in a number of fields. The most thorough of these is the study of musical talent. An analysis of musical performance indicates that some of the qualifications are: accurate discrimination of slight differences in pitch; tonal memory; discrimination of time and rhythm; acuity of hearing; and so forth. Such an analysis is not necessarily complete. There may be other factors which help to make a good musician that are not identified. Insofar as these qualities are factors in what we call *musical talent*, their measurement ought to furnish data for the prediction of musical performance or musical appreciation.

The results for two subjects are shown in the charts of

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[5] E. K. Strong's Vocational Interest Blanks can be secured from the Stanford University Press. For a complete discussion of these tests, see *Changes in Interests with Age* (Stanford University: Stanford University Press, 1931), by the same author.

Figure 107. The scores are given in centile rank. Thus, a rating of 90 means that only ten per cent of the individuals tested did better than this one. The first chart presents the rank in the various tests of a young man who has always wanted to study music but who has been discouraged by his family, presumably on the ground that music is not a manly art. The second chart is that of a young woman who has not profited by her extensive musical training. The first subject evidently ranks very high in many of his tests and is

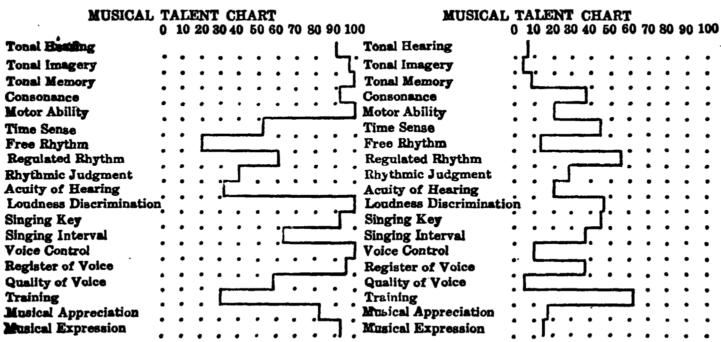

FIGURE 107.—CHARTS OF MUSICAL TALENT. (*Seashore.*)

seriously deficient in only rhythm, acuity, and training; while the second subject, in spite of her great training, ranks considerably below average in nearly all of the tests.

Summary

The proper construction of any tests requires that we first determine what qualities we want to test. The tests must then be consistent and agree with the criterion—that is, they must have a high degree of reliability and validity. When we have the scores on such tests, we must use some means of establishing what a particular score means. We must have norms. The centile distribution or the standard error is most frequently used for this purpose.

It is possible to set up such tests and predict, with a high degree of accuracy in a great many tasks, the degree of success of those who have taken the test. In some fields, which have

not been broken down into special subgroups, it is not yet possible to use these methods. Since, however, it has been found that the special interests very closely parallel the special abilities, it is possible to predict degree of success, by first discovering the special interests of professional groups and then assigning a predictive value to the interests of the individuals who are contemplating a professional career.

18

Personality

You may hear someone say: "She has a nice personality"; or: "He is intelligent, but he lacks personality"; or "He has a forceful personality." These assertions seem to set personality apart as something that a person may or may not possess, something mystical that is given to a person. Your study of psychology thus far has undoubtedly led you to be assured that there must be something wrong with this concept of personality. Other concepts regarding behavior or the nature of man have been found to lose their mystical character as soon as they have been carefully examined. Our concept of personality, you may say, must also relate rather directly to behavior, and represent an extension or a continuation of the principles we have evolved thus far. You are correct in your reasoning so far. Personality is no mysterious something that some have and others do not have.

You will also find that *personality* is a term employed to describe the value of a person as a social stimulus. A "weak personality" or a "strong personality" implies that you mean that *personality* refers merely to the way a person affects others. This is a rather limited use of the term, although some psychologists use it in this restricted sense. It seems more appropriate to use the term to apply to the whole person. The word *person* is derived from the Latin *"persona,"* which originally meant *the mask worn by an actor.* Later, it meant *the actor,* and, finally, *any human being.* "PERSONALITY,"

THEREFORE, IS THE QUALITY OR STATE OF BEING A PERSON. It is that which constitutes or characterizes a human being. To THE PSYCHOLOGIST, IT IS THE TOTALITY OF THE REACTION PATTERNS AND REACTION POSSIBILITIES OF EACH INDIVIDUAL.

This broader view, you will see, covers practically all that has been discussed in the preceding chapters. It includes the social-stimulus value of the person; but it includes also his characteristic motives, his emotional behavior, habits of thinking, and any other characteristic that may be considered distinctive of him as a certain human being. This concept of *personality* makes the statement "He has no personality" meaningless. Everyone has a particular pattern of habits and potentialities that make him different from everyone else. What we usually mean when we use that phrase is that the individual's personality is not particularly effective in its value as a social stimulus. But to say that he has "no personality" is to say that there is nothing about him which makes him different from others, which, of course, is not true.

Other animals possess characteristics that describe individual members of their species. We sometimes hear these described as "personality differences." This is a loose use of the word *personality,* but it may be condoned so long as you remember that only characteristics of dogs or horses or monkeys are being described. Thus, one horse learns more readily than another, is more easily managed, or is less easily frightened. Even white rats attack laboratory problems differently. Some rats become more emotional in frustrating situations than do others.

This chapter is really a review of all the foregoing discussion in this book. Previously, we have dealt with more or less isolated phases of human behavior, in order to arrive at certain general principles. We seemed to have taken man apart, not to have dealt with the whole person. This analysis may have left you a little uncertain regarding what the total human being is like. Now you want to know something about personality. Many students have expressed this attitude. They say: "We don't care about these details; we are interested in human nature—personality, if you please." In order to meet this requirement, let us try to make a survey of all that must be

included in such a study. What are some of the aspects of human nature or of human behavior that are essential to a satisfactory understanding of personality? In how many ways may persons differ? We can only touch upon some of the high spots in a single chapter.

Factors Influencing Personality

Physique

We have seen that one way in which man is superior to the ape is that man can assume an upright posture. But men differ widely in physique. There are tall, slender men; short, stocky men; and all sorts of variations between these. Naturally, you would expect these gross structural differences to affect behavior. The tall, broad-shouldered, muscular man will attack with physical force many problems that the less athletic man would "use his head" for. You can observe many other characteristics of behavior that are easily traceable to the physical build of the individual. The handsome woman may not be so gracious as the woman who is physically unattractive. Physique influences the development of personality, but it must be remembered here as elsewhere in what follows that there is danger of carrying this principle too far. Not all pretty women are ungracious, and not all muscular men fail to use their heads. There are other factors at work. When you are inclined to attribute complex behavior patterns to a single cause, stop and reconsider your generalization. There is a great tendency to seek too simple explanations.

Attempts have been made to classify persons on the basis of some physical trait or group of traits. The size and shape of the head, the facial features—such as the nose, ears, and mouth—have all, at one time or another, been thought to indicate personal differences. We still use *highbrow* and *lowbrow* to express opinions regarding the intellectual attainments, although no demonstrated proof of any correlation with intelligence or scholarship exists. Phrenology, at one time, was believed to offer a means of determining numerous traits. This grew out of the belief that the brain is the seat of the

mind. Since it was thought that the mind was made up of several discrete faculties, it seemed logical to suppose that the brain also was divided into several functions, each of which was localized in a certain part of the cerebral hemispheres. There was no anatomical or experimental proof of this position; nor has there ever been. It was simply a good, logical deduction that sounded as though it should be true. But one needs only to consider the microscopic character of the layers of the cortex and the great variations in the thickness of skulls, from paper-thin to half an inch, to realize how futile such an attempt at "character reading" must be.

Further attempts have been made to discover physical types on the basis of gross structural differences. It has been proposed,[1] for example, that most persons fall into one or another of three types:

1. The *pyknic* type, possessing a broad head, long trunk and short legs, narrow shoulders and broad hips, and abundant flesh. This short, stocky type of person is supposed to be subject to emotional instability. Among the insane, the pyknic is inclined to the manic-depressive psychosis. We shall describe the insane later.

2. The *asthenic* type is distinguished by a long head, short trunk and long legs, narrow shoulders and hips, and very little fat. Temperamentally, this type is supposed to be seclusive or withdrawing.

3. The *athletic* type is described as possessing a fairly long head, broad shoulders and narrow hips, and larger muscles.

At present, no satisfactory experimental evidence is available to warrant the belief in personality types that correspond to these physical types. Unlike phrenology, however, there is some basis for the belief that physique may correlate with personality for the following reason: It is known that the glands of internal secretion, at least some of them, play an important role in physical development. You have read accounts of a boy in Illinois who was over eight feet tall at the age of twenty,

[1] Kretschmer, E., *Physique and Character* (New York: Harcourt, Brace and Company), 1925.

and you have seen dwarfs. A part of the pituitary gland has something to do with these cases. You have seen people with large bulging eyes, extremely slender and active individuals, as well as the fat, slow, sleepy person. In these cases, the thyroid gland seems to play an important role. These glands exert an influence, not only upon skeletal structure, but also upon the behavior. But the interrelations between the glands and the nervous system are too complex to allow any adequate classification of types. Some day we may know enough about the functions of the glands and about the various aspects of personality to make classifications of this sort, but today all we can do is to identify the extreme cases: "This man has an overactive pituitary." "This woman is a hypothyroid case."

We started this section by saying that physique is related to personality. What can we now conclude? Simply this: THE SIZE, PROPORTIONS, AND AMOUNT OF FAT ARE IMPORTANT DETERMINERS OF OUR BEHAVIOR, BUT THEY ARE NOT THE ONLY FACTORS TO BE CONSIDERED IN A STUDY OF PERSONALITY. The tall man may be embarrassed in a crowded room; the fat girl does not like to be seen in a bathing suit. Whether these two are embarrassed or not, they react differently to their own physique than they would to a different physique, could they alter their present proportions.

Sensory differences

The influences upon personality of the senses are not so obvious as the influences of physique. Of course, if a person is blind or nearsighted or deaf or hard of hearing, you can recognize that such a defect must alter the personality from what it would otherwise have been. But persons differ in slight degrees in these respects, and these slight differences modify behavior more than you realize.

Individual differences in sensory capacity may be of considerable importance in shaping the views, interests, and attitudes. Slight sensory defects or slightly more sensitive receptors may make a great difference in outlook and attitude. If a person's visual or auditory acuity is above normal, he may be more interested in things about him. If, on the other hand,

the organic receptors are especially sensitive, he may become more interested in his own well-being. You have perhaps observed a friend who does not seem to be concerned with his own ills. He is too engrossed in what he is doing. Then there is the person who cannot study, or cannot go to parties because he is "not very well," or is disturbed by the social contacts. He is too sensitive. Some react to slight noises, others to temperature changes.

These exhibitions of sensitivity differences are not always the result of the receptors alone. The training of the individual has a lot to do with it. But whether they are due to structural differences or to training, the slight variations in sensitivity to stimuli play an important role in personality.

Intellectual differences

We use the term *intellect* here to include the capacities of attending, learning, remembering, reasoning, and imagining. The preceding chapters have discussed the numerous factors involved in these activities. We might have used the word *intelligence* to cover these same processes, except that it implies the native capacity to learn or deal with our environment. We are at present more concerned with both heredity and training, as they work together to make the personality or individual characteristics of the person.

In a given situation, some individuals learn more quickly than others. It is obvious that the whole attitude of the slow learner will be different from that of the quick learner. One will have more time for other things. He will be able to learn more and will be inclined to want to learn more. If the slow learner is highly motivated, is determined to reach his goal, he develops habits of work in this field that may be lacking in the case of the fast learner. These differences in learning and habits of work are essential characteristics of the individual.

Attention is determined by a variety of factors that we have classified as *environmental* and *personal.* The total background of experience governs attention. Some have reacted differently to this training than others. Or, should we not say that their training has been different? At any rate, one in-

dividual attends or is interested in one situation; another individual is interested in something else. Some can attend to one subject for a long time; others are "scatterbrained." Attention shifts frequently.

The person who has difficulty remembering may learn to observe relations, to think things through. He may use his moderate supply of facts to a greater degree of efficiency. This does not mean that the one who is slow to learn or who forgets more readily is the better reasoner. It simply means that these are also variables that must be taken into account when we examine the total picture offered by one's personality.

Emotional differences

Closely related to habits of thinking are the emotional habits. You will recall that emotion and reasoning are two modes of dealing with a situation for which you have no ready response. If a person has learned to meet emergencies by solving the problem, we say that he is *stable, dependable, capable.* If he becomes disorganized, we say that he is *emotional, sensitive, flighty.* THE EMOTIONALITY OF AN INDIVIDUAL IS ONE OF THE MOST PROMINENT CHARACTERISTICS OF HIS PERSONALITY. His fears and prejudices, and his ability to meet the emergencies of everyday life color his whole adjustment.

Temperament is another term that is applied to the total emotional constitution or predisposition. Some individuals exhibit a deficiency in feeling and emotion. Nothing seems to disturb or excite them. They are phlegmatic in temperament. Others show a general susceptibility to emotional reactions. They exhibit great elation or great depression under circumstances that arouse only mild responses in the average person. Temperamentally, they are the excitable or vivacious people. In between these two extremes there are all degrees of emotionality, including those who are extremely emotional under certain conditions and not under others.

This brief review of some of the factors that enter into the determination of the differences in individuals will make clear the enormous complexity of the personality of any one of us. Again, we must emphasize that all that has been described in

the preceding chapters must be taken into account. Heredity, physiological conditions or drives, the physical and social environment, the successes and failures in learning to adjust to the world in which you live—all play a part in shaping the personality. It is now our task to consider the "whole person," to determine how these various characteristics function together in what we call *you,* or Mr. Jones, or Miss Smith. You have your good points and probably some of which you are not so proud. It is not uncommon for us to project our own faults into the personalities of others, so that we see in our friends and associates the very shortcomings of which we are guilty. Where did these good points, as well as the faults, originate? You sometimes think of that; but very frequently, you just assume that the person is perverse in his behavior.

Principles of Personality Development

We differ from one another in personal characteristics because of our abilities and the social or educational background, and because we are constantly meeting and adjusting to new situations. We are constantly changing. Your high-school chum went to another college. When you meet him next summer, you may be disappointed in him. "John isn't the same fellow I used to know." You are not the same either. Let us hope the change is for the better in both cases. Whether it is change or greater stability that is being sought, there are some important principles in personality development that should be considered:

1. *New habits or reaction patterns are constantly needed.* The young infant is making a satisfactory adjustment if he is sufficiently skilled in the feeding responses, cries when hungry or in pain, and sleeps fairly regularly. At eight months, he must have acquired other habits; and at three years, there are still other habits—walking, talking, obeying simple commands, and adjustment to emotion-provoking situations, the control of temper tantrums, and some recognition of the rights of others. It is important to remember that each successive step in the development of personality is a matter of learning. All

too frequently, it is assumed that certain of these habits and skills appear more or less spontaneously and full-blown, simply because an individual "is old enough." When he is old enough to go to college, he should have acquired a great many more skills, such as independence in the care of himself, ability to make decisions, and a proper balance between sentiments and intellectual and physical types of behavior, to say nothing of those special skills of reading, writing, and planning his own day. Imagine the student who cannot register, cannot select his courses from the catalogue, and cannot find his way to the classrooms. A parent or his adviser must do all this for him. THE IMMATURE PERSONALITY IS THE RESULT OF FAILURE TO DEVELOP THE SKILLS OF THAT AGE LEVEL.

2. *The elimination of useless habits is necessary.* When you were a child, you behaved like a child; but when you become an adult college student, you should put away childish habits. The three-year-old no longer uses sucking as a food-getting procedure. If he does, we attempt to do something about it. It is necessary for the young child to depend to a large extent upon the parents or some adult to supply his personal needs. It is expected that he will cry when injured or frustrated. For the adult to exhibit these childish traits is an indication that something was wrong with him as a child or with his training. Little Johnnie, at fourteen years, is the baby of the family. He is watched over by his mother, who washes his face and tells him when to put on his overcoat. He is never allowed to go far from home alone. Contrast his development with Bill, who, at eight years, was in the habit of going to the movies; had his own allowance, which had to be stretched over the week; and who washed his own hands and face. At fourteen, he made a trip to Washington, D. C., on the bus, a distance of 400 miles.

Of course, most adults had little to say about the particular habits that they were allowed to develop when they were children. They are not to be criticized for the mere presence of these childhood habits, but they are to blame if they permit these habits to persist. The adult who "behaves like a child" or who persists in the habits associated with a former environ-

ment now no longer useful displays an embarrassing defect in his personality. Symptoms of this inadequacy appear in such statements as: "At home, we never did it that way"; "My high-school teacher always let me"; "Mother always said . . ."; "I never belonged to a club that required . . ."; and so forth. **NOT ONLY THE ACQUIRING OF NEW HABITS, BUT THE BREAKING OF OLD ONES THAT ARE NO LONGER USEFUL IS IMPORTANT TO PERSONALITY DEVELOPMENT.**

3. *Practice habits that will be useful later.* We are prone to take the attitude that what we do today does not matter: "When I get a job, I'll work hard, but not now." Parents often take this attitude, also, in regard to their children: "I don't want Johnnie to be exposed to hardships now. There will be so much of that when he grows up." Too frequently, we fail to realize that the child must learn to live in a particular environment, in spite of the fact that it may not be ideal. Boys must meet boys who are rough and who do things that we consider undesirable. Girls must learn that the competition for attention is keen and real; that acceptance by a group or by an individual is a matter of what they do, not what they hope they are. It is therefore necessary that they learn to meet these situations, rather than be protected from them. It is necessary that we learn to get along with people as they really are, rather than as we would like to believe they are.

As the individual comes in contact with his social world, he must give and take. He must learn first to make social adjustments in the home. If the situation there provides the opportunity for him to learn the limits of his own freedom, the rights of others in the larger social environment will be easy for him to recognize. We have shown in the discussion of motivation (Chapter V) that the types of attitudes and ideals the individual develops are the outgrowth of all the habits that he has developed in reaction to situations as they have arisen.

TO SUFFER PAIN OR DISAPPOINTMENT, TO OVERCOME OBSTACLES, TO GAIN SATISFACTION IN THE SOCIALLY ACCEPTABLE ACTIVITIES, TO MEET SITUATIONS THAT ARE WITHIN THE LIMITS OF HIS PRESENT DEVELOPMENT OR STAGE OF MATURITY—THESE ARE ALL A PART OF THE FOUNDATION OF THE "STRONG" PERSONALITY.

Getting Along with People

The importance of making adequate social adjustments has been emphasized time and again throughout this book. You have also heard many times that college consists of more than the courses you take. Get acquainted with your fellow students; make friends. It is not necessary for you to justify this effort in terms of the "lasting" friendships you will make. Studies show that college friendships are usually maintained after college only by the most determined sentimentality. Take your college experience, therefore, as an opportunity for you to practice getting along well with people. Whether you intend that these people are to become intimate acquaintances or not is beside the point. You are always going to have to get along with—put up with, if you like—all kinds of people.

Now is a good time to develop those skills that later will help you make these adjustments to others. There is not much danger that most of you will devote too much time to your studies and neglect the social life of your campus. The greatest danger is that you will not take advantage of your opportunities to improve your own reactions to other people. You may be so fortunate as to be an agreeable person when you enter college. What makes one student popular, another well liked but not popular, and still a third disliked? It is worth your serious thought. But when you have discovered your shortcomings, *do* something about it. We would almost be justified in saying do *anything*. You will soon learn whether what you do is wise or not. The thing to be avoided is simply doing *nothing*. The latter is the procedure, if it can be called such, employed by most ineffective personalities in college. "I got along all right at home. It must be the high-hat attitude of the students that makes it hard for me to get along here." Such a student spends many unhappy days in college—and lonesome nights.

Common annoyances

It is not always the easiest thing to learn just what it is about you that people do not like. Remarks such as "Your best

friend won't tell you" indicate that our friends are not always the ones to turn to for help in this respect. As a matter of fact, one may gain the impression from one's friends that he has no faults. Friends and relatives often learn to tolerate or overlook flaws in a personality that strangers will not permit. Thus, it happens that a most fruitful source of information pertaining to our own drawbacks can be found in lists of annoyances that apply to people in general. The following items were most frequently reported by several hundred college students who were asked to list the things they found most annoying to them in some other person: [2]

1. Telling me how to drive.
2. Coughing in my face.
3. Telling me to hurry when I am hurrying.
4. Continually criticizing something.
5. Belching.
6. Crowding in front instead of waiting his turn.
7. Bragging about himself.
8. Poor loser in a game.
9. Cheating in a game.
10. Continually talking about his illness.
11. Inquisitive about my affairs.
12. In conversation--not paying attention to me.
13. Criticizing the food at the table.
14. Hostess repeatedly urging me to take food I don't want.

You may joke about jollying the professor—*apple polishing* it is called in some colleges. Some students are too "honorable" to indulge in the practice. For fear that they will be thought to be apple polishers, they lean over backward to avoid it. Now, there is a legitimate type of apple polishing that should be encouraged. You have to get along with your instructor, as you have to get along with other people. Study him; try to discover his interests and eccentricities, as well as what he expects of you in his course. You don't have to submerge your own "individuality" to do this. It is always better to make people like you. There is no use of arousing antagonisms. After college, you will be required to make a good im-

[2] Cason, H., *Common Annoyances,* Psychology Monographs No. 2 (1930), Vol. LX.

pression on many people, many of whom you may cordially dislike. These will include perhaps your employer, some of your in-law relations, neighbors, competitors, and other business and social associates.

These are suggestive of some of the things to guard against. You may find other disagreeable features in your own case. Special groups make special demands to be neat, not to overdress, to be clean-shaven, dependable, patient, sympathetic, a good listener. Perhaps better than any suggestions we have made so far is the one that is so difficult to follow: If it is possible, you may receive lasting benefit at the hands of someone qualified to give you a thorough "going-over" with respect to your present personality development. There are many who will be only too willing to tell you just what is the matter with you but who will simply be doing what you do when you become overcritical of others. They are projecting their own faults into your personality and may, in fact, give you an erroneous impression of the areas in which you should try for some improvement. What we are suggesting here, rather, is that you consult someone who is qualified by experience and training to make suggestions concerning things you might do. A friend or relative, for reasons that we have already stated, is usually not the best person to do this. Teachers, advisers, and counselors are best qualified, but they will not offer their advice unsolicited. They will have to be asked—by you. Therein, of course, lies the rub. It takes a good deal of courage to ask for what amounts to a dressing-down. Some students scrupulously avoid it. "They can't take it."

Marital happiness

One of the most important social situations is the marriage relation. Young people are more cognizant today of the problem of personal adjustment of two personalities in marriage than they have ever been before. The reports of the high divorce rate and the knowledge that many homes are not happy homes make them consider seriously what will happen in their own case. Psychologists have been studying this problem. They have tried to discover what the important factors are

that make for a happy marriage and what factors are to be found most frequently in homes where divorce occurs that are not found in happy homes. The complete answer is not yet given. There are too many angles to be investigated.

Among other methods used, one group of investigators applied a *personality-inventory technique.*[3] Each member of a pair was asked to answer a series of questions by "yes" or "no." It was found that happy pairs agreed in their answers to the following questions:

1. Does it make you uncomfortable to be "different," or unconventional?
2. Are you easily discouraged when the opinions of others differ from your own?
3. Do athletics interest you more than intellectual affairs?
4. Do you find conversation more helpful in formulating your opinions than reading?
5. Do you like to bear responsibilities alone?
6. Do you want someone to be with you when you receive bad news?
7. Does it bother you to have people watch you at work, even when you do it well?
8. Do you usually try to avoid arguments?
9. Do you especially like to have attention from acquaintances when you are ill?
10. Are you willing to take a chance alone in a situation of doubtful outcome?
11. If you come late to a meeting, would you rather stand up than take a front seat?
12. Would you "have it out" with a person who spread untrue rumors about you?
13. Do you prefer a play to a dance?
14. Do you prefer to be alone at times of emotional stress?
15. Do you usually prefer to work with others?
16. Do you like to be with people a great deal?

There were other questions on which they disagreed, for example, the following:

1. Have you ever crossed the street to avoid meeting some person?
2. Are you much affected by the praise or blame of many people?

[3] Terman, L. M., and Buttenwieser, P., "Personality Factors in Marital Compatibility," in *Journal of Social Psychology* (1935). Vol. VI, pp. 143–171, 267–289.

3. Do you usually prefer to do your own planning alone, rather than with others?
4. Do you find that telling others of your own personal good news is the greatest part of the enjoyment of it?
5. Are you thrifty and careful about making loans?
6. When you are in low spirits, do you try to find someone to cheer you up?
7. Can you usually understand a problem by studying it out alone rather than by discussing it with others?

It would seem that happy marriage depends upon two personalities that agree on some things but complement each other in other interests. Not only the amount of agreement and disagreement, but also the specific things are important. You cannot go by a ready-made list of items, such as the one used here, although it is a good starting point. A happy marriage is something you have to work for. It requires two persons studying two personalities.

Personality Traits

When we attempt to analyze personality, we are inclined to look for some few fundamental characteristics that may be considered independent variables. We would like to believe that some six or seven of these characteristics could be discovered that are to be found in all individuals, differing only in degree. The search for such traits has not proved satisfactory. As a matter of fact, there may be as many traits as we find it necessary or convenient to use in our study.

WE MAY DEFINE "PERSONALITY TRAIT" AS A GROUP OF HABITS THAT MAKE UP A PATTERN OF BEHAVIOR. For example, we may consider *honesty* as a trait. We mean that the individual will not steal, will not cheat, and will not lie. We mean that he has well-defined habits with respect to situations demanding honesty. This is not a general trait that some possess and some do not. A man may have well-defined habits of honesty with respect to other individuals or regarding money matters and yet cheat the Government or a corporation, or cheat in an examination. The degree of honesty and its specificity is represented by the kind of habits developed.

In the same way, we may speak of such traits, or habit systems, as *leadership, friendliness, cheerfulness, persistence, courage.* It will readily be seen that some of these so-called *traits* overlap, that habits involved in one are also found in another. This merely serves to emphasize that our classification of traits is arbitrary and is based upon their social significance in our study.

WHEN WE HAVE SELECTED A GROUP OF TRAITS, EACH MUST BE CAREFULLY DEFINED ACCORDING TO THE SITUATIONS THAT ARE TO BE CONSIDERED. For example, *leadership* is a well-recognized trait; but a person may be a leader in one situation and not in another. *Leadership* may mean that the individual possessing that trait has developed habits of taking the initiative in the more directly social situations. He is a leader of men, a good executive or commander; he does not hesitate to express his opinions or to act on them. On the other hand, *leadership* may be in the realm of the more implicit reactions that we have defined as *thinking.* In this case, the individual has developed habits of analyzing situations and of reaching new conclusions irrespective of the opinions prevailing in his social group. He is less restrained by the traditions or habits of thought of the era in which he lives.

Methods of Studying Personality

At present, we may list four methods of investigating personality: (1) the case-history, or biographical, method, which is purely qualitative; (2) the rating method, which attempts to state qualitative judgments in more objective terms; (3) the experimental method, which seeks quantitative measurements of specific traits; and (4) the self-rating method.

The biographical method

A method widely used is the *case-history,* or *biographical, method.* It may be in the form of a short interview in an employment office for the purpose of selection of employees,

or it may be used by student advisers. The more thorough investigations are made by the psychiatrist in the investigation of the previous history of a patient suffering from a neurosis.

The chief purpose in this method is to make a thorough study of the early life of the individual; his physical and social environment; and the habits, attitudes, and experiences that affect him in later life. In other words, the investigator seeks to interpret the individual's interests, hobbies, likes, and dislikes in the light of his childhood experiences. Attempts have been made to apply this method also to the study of historic personages, authors, artists, and political leaders.

Rating methods

The man-to-man rating method. When we have selected a group of traits that seems adequate for any specific purpose, it is necessary for us to have some standard of judgment for determining the degree to which an individual possesses these traits. One of the rating methods employed is known as the *man-to-man rating.*

The individual who is to do the rating first selects for one of the traits a man of his acquaintance who possesses this trait in the highest degree. He also selects a man who possesses this trait in the least degree of any one of his acquaintances, and one who possesses this trait in such a degree as to fall as nearly as possible midway between the first two men. He likewise chooses a man who falls as nearly as possible between the first and third, and another who falls between the third and fifth. He thus has a standard based upon five men who, in his own judgment, are equally spaced as to the degree in which they possess this trait.

The same procedure is followed for each of the other traits. The men representing these traits might not be the same in each case. It is also to be presumed that the rater is intimately acquainted with the individual he is about to rate, or that he has some means of determining the degree to which the subject possesses these traits. If he is rating several individuals, he

should rate each one on one trait, then proceed to rate each on the second trait, and so forth.

The graphic rating method. Another method that is frequently employed is the *graphic rating method* (Figure 108). The blank used provides a line for each trait, usually showing the degrees of that trait. The rater is to make a check on the line to indicate his judgment with reference to the degree that this individual possesses the trait. If he decides that the individual is above "ordinary" in manual habits but does not "understand readily through manipulation," the check is made somewhere between these two terms. This procedure is followed for each of the traits involved. It is assumed that each rater will interpret the scale in the same way.

Halo effect. By rating each individual upon one trait before rating on the next trait, we are able partially to avoid the error of the personal bias or prejudice. Usually, however, we do find our judgment warped by our general impression of the individual. If he is high in scholarship, we are likely to consider him high in comprehension, application, or dependability. If he is particularly low in one of these traits, we are inclined to rate him low in the others.

It is generally found that greater accuracy is obtained if the number of traits to be employed is small. Five to seven traits are more satisfactory than twenty traits. However, in some instances where a thorough examination of personality is required, a much longer list that is more detailed and searching in its purpose may be employed.

One list of traits is a personal inventory, which is divided into fourteen general classes, and under each are several specific items. For example, the items under *self-assertion* are the following list of questions:

1. How much effort to shape surroundings?
2. How independent of the opinions of others?
3. How much tendency to assume leadership?
4. How ambitious in material things?
5. How able to bear up under difficulties and misfortunes?
6. How able to face crises?
7. What inclination to face danger?

1. *Manual Habits:* Ability to understand by manipulation (laboratory methods).	Superior Manual Habits	Understands Readily Through Manipulation	Ordinary	All Thumbs	
2. *Verbal Habits:* Ability to understand and use written and spoken language (lecture and reading methods).	Writes and Speaks Lucidly and Clearly	Ordinary	Often Confused	Writes and Speaks Unclearly	
3. *Maturity:* Developed adult habits. Freedom from childhood habits and viewpoint.	Adult	Adolescent	Childlike	Infantile	
4. *Accuracy:* Precision, attention to details, intellectual honesty.	Precise	Painstaking	Careless	Very Unreliable	
5. *Industry:* Application, zeal for the task, capacity for sustained effort, perseverance.	Always Busy	Industrious	Indifferent	Tires of a Task Easily	

FIGURE 108.—GRAPHIC RATING SCALE. The degree a trait is judged to be possessed is indicated by a check mark on the horizontal line.

The experimental method

On the assumption that the rating method generally proves inaccurate and is particularly subjective, in the sense that one must rely entirely on the opinion of the rater, efforts have been made to develop *experimental techniques* that would give quantitative measurements of the degree of the trait possessed. As most of the traits usually considered are extremely complex systems of habits, the difficulty usually rests upon the fact that the trait is not clearly defined.

One experiment[4] is suggestive of some of the attempts that have been made. The experimenters attempted to measure aggressiveness by the association method and by steadiness of eye fixation during an interview. The association test employed as stimuli words that might call out associations which would indicate whether the individual was inclined to meet social situations positively or negatively. In the eye-fixation test, the individual, during a part of the experiment, was required to look fixedly at the eyes of the experimenter while an assistant counted the number of times that he glanced away.

As a check upon the adequacy of the experiment, each subject was rated by those who knew him best. The success of the experiment, therefore, must be decided upon the basis of the adequacy or accuracy of the rating method used.

The self-rating method

Another test method that yields results which may be treated quantitatively is really a *self-rating technique.* The subject is asked to state what adjustments he would make in each of a large number of situations. By the use of this method, an extended study of the traits of ascendence and submission was made.[5] The aim was to present, in verbal form, a fair sampling of social situations which the subjects might be expected to meet in daily life—for example: "Are you

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[4] Moore, H. T., and Gilliland, A. R., "The Measurement of Aggressiveness," in *Journal of Applied Psychology* (1921), Vol. V, pp. 97–118.

[5] Allport, G. W., "A Test for Ascendence-Submission," in *Journal of Abnormal and Social Psychology* (1928), Vol. XXIII, pp. 118–136.

embarrassed if you have greeted a stranger whom you have mistaken for an acquaintance?" "At a reception or tea, do you seek to meet the important person present?" The replies were scored as plus (*ascendent*) or minus (*submissive*). The total score of each subject was the algebraic sum of the scores of the separate items, a procedure of doubtful mathematical merit.

FIGURE 109.—DISTRIBUTION OF SCORES IN A TEST OF ASCENDENCE AND SUBMISSION. (*G. W. Allport.*)

Figure 109 gives the distribution of the total scores of 400 college men. It will be seen that a few possessed the trait of ascendence to a marked degree, while a few were markedly submissive. A large percentage of the subjects showed only a slight ascendent tendency. None of the subjects was entirely consistent in his replies. There was considerable variation in most cases, according to the situation. This is what would be expected. The dominant or ascendent person does not maintain this attitude under all conditions.

One thing which the data in Figure 109 illustrate is that individuals distribute themselves more or less in accordance with the normal frequency distribution with respect to this

personality trait. This distribution is a commonplace whenever any representative sampling of people is tested with a valid measuring device. Seeing that individuals tend to distribute themselves in this manner should make us very skeptical concerning the existence of *personality types.* Unless we are arbitrarily going to draw lines through such a distribution, we must remember that each personality trait is exhibited in varying degree by all people. The individual who talks about a *personality type* reflects his ignorance of this aspect of the distribution of traits. There is no such entity as the "intellectual type," the "social type," the "go-getter type." All individuals possess these combinations of traits to some extent; and to single out certain combinations for such a designation means that, intentionally or unintentionally, we have disregarded all of those who fall in intermediate categories on the continuous scale that analysis shows to be characteristic of all traits. Thinking of personalities in terms of types is usually the result of inexperience on the part of those who do so. Their background and social contacts have not afforded them the opportunity of becoming acquainted with those in intermediate categories. You can, therefore, display a certain amount of sophistication with regard to these matters by refusing to consider individuals as falling into certain arbitrary and narrowly defined *personality types.*

Summary

The college student is often interested in what he can do to improve his personality. It must be recognized that, if habits are so important to the development of personality, it is useless to expect that you can remake your personality overnight. Frequently, a student assumes that the mere fact that he takes a course in psychology ought to be all that is necessary for his formation of the correct personality. Knowledge alone does not change our habits. It is only as we are willing to undergo the slow process of reorganizing and of developing new habits through practice that we can make any noticeable change in our personality.

We have repeatedly pointed out that the best method of making adjustments when we meet a difficult situation is to analyze the situation, including the environment and our potentialities, and then to make the best of our possibilities. This principle may be extended to the more general facts of personality. As you meet varying situations in college and in your general social environment, you will have ample opportunity to observe what your own inadequacies are; and you may then set about developing habits that will enable you to make the correct adjustments.

It may be that you will find that you are easily embarrassed in the presence of others. Then, instead of withdrawing from the social group, practice meeting the demands of the group, and you will soon acquire a feeling of freedom in public places. If you find that you have inadequate habits of study, that you are inclined to give up easily or fritter away your time, the only remedy for your deficiency is persistent endeavor in application, which brings its own rewards. If you are dependent upon others, practice in making your own decisions—even though they are not so good as those someone could make for you—will develop the habit of independence. In the course of four years, a great transformation may be made; but it must be remembered that you have already spent twenty years in the formation of habits, and these cannot be easily set aside.

19

Abnormal Personalities

The Concept of Abnormality

The belief is very commonly held that the insane person is strikingly and peculiarly different from the normal individual. Such a belief is the natural result of the *type* thinking referred to in the preceding chapter. A person is either sane or insane, and that is all there is to it. Such phrases as "touched in the head," "possessed by the devil," "lost his mind," all indicate that, deep in our culture, there is this belief that the insane person is a different kind of person; that the forces which determine his behavior are not in any way like those which govern normal patterns of adjustment. They also convey an "all-or-none" conception of insanity; a person is entirely insane or not insane at all.

Modern psychology has gone a long way in an attempt to discover just what is the basis of insanity and to suggest concepts of insanity that will prove helpful from the standpoint of diagnosis and treatment, as well as prevention. To round out our study of psychology, we may now turn to the field of abnormal behavior. Not only may it help us to understand this particular aspect of behavior, but some of the things we may learn can be of value in establishing a clearer conception of the normal person.

During the preceding chapters, we have gone to considerable pains to develop the concept of *frequency distributions.* We have also pointed out that all measurable aspects of the human personality fall into some variation of the normal frequency distribution. In keeping with the scientific dictum that "ev-

erything that exists, exists in some amount," we must further agree that the as yet unmeasured traits of personality will also show the distribution characteristics of those that have been measured.

As we scan these distributions, we are impressed with the fact that by far the majority of individuals fall within a middle range of values representing the possession of a trait. Most of the people you know will fall within this middle range for most traits. But at the extremes of the distribution, there are a relatively few individuals who either do not possess or exhibit

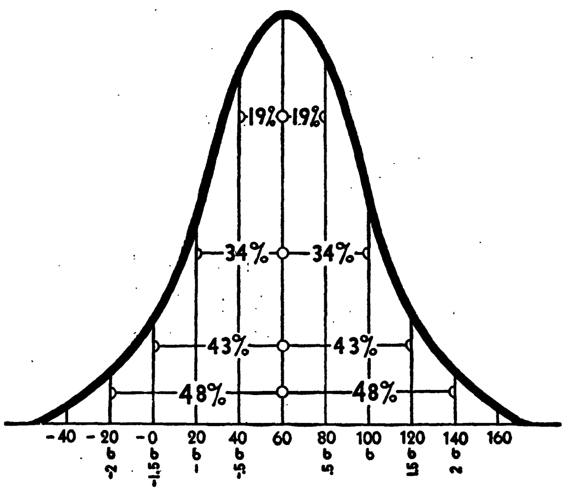

FIGURE 110.—NORMAL FREQUENCY CURVE.

the trait at all, or who exhibit it to a very marked degree. With reference to the number of times we would encounter these people in the general population, we would use such adjectives as *rare, extreme, unusual, atypical, abnormal.* All of the adjectives are practically synonymous.

Psychologically, then, a person is *abnormal* if he deviates markedly from the behavior of the group as a whole. Just how much deviation there can be and the individual still be called *normal* is a highly arbitrary matter. Many of us do not realize what an arbitrary matter this decision is. If you will examine the distribution curve in Figure 110, you will note

that the base line is a continuous scale; there are no marked divisions on it. The particular point at which you will draw a line and say: "Those who exhibit more than this amount of a personality trait shall be called *abnormal,"* is a very delicate matter, and requires making hairline distinctions at best. One reason that this problem has not concerned you in the past is that, either you have never met individuals who fall into intermediate classes, or you have met these individuals and forced them arbitrarily into one or the other of your favorite categories.

We will note later that one of the symptoms of certain abnormalities is the presence of *delusions,* or false beliefs. We would say, for instance, that a patient who believed that he is a famous king or ruler and that the inmates of the hospital in which he is confined are his chosen princes or members of his court is definitely insane. But at the same time, we must admit that such a belief is different only in degree from our own belief that our personalities contain few flaws and that our own circle of friends or sorority or fraternity is just a little superior to others. This is what we mean when we say that "traits differ in degree." Believing that one is a king is not a different *kind* of belief; it is simply an *exaggerated* belief in one's own worth-whileness.

The particular point at which we are to draw the division between the normal and abnormal has, for a long time, been a very important consideration in the affairs of man. "The law," as it is sometimes called, is terribly confused in this matter. One needs only to examine the proceedings of many cases involving the question of insanity to discover how hopelessly involved the matter has become. Testate capacity, testimonial competency, and criminal responsibility are frequently decided by the most bizarre methods.

Smith kills Jones, knowing that he is killing Jones and that it is illegal to kill any man. Smith believes, however, that he is under the command of a supernatural force or Divine Being, who has instructed him to kill Jones for the betterment of the human race. Is Smith insane? Is it unusual to believe that one is at the command of a Divine Being? Was it wrong to

kill Jones? Was it immoral? Was it illegal? Is Smith to be held responsible for his act? As you can readily see, such questions have kept courtrooms buzzing and legal documents multiplying for many years. Unfortunately, instead of clarifying the matter, the multiplicity of writing and talking on the subject has simply served further to confuse the issue. It is not until one gets away from the legal tangles involved that a clear solution seems even possible. Such attempts have been made in many states, so that the matter of sanity is decided by a board of experts, which renders its decision entirely independently of the legal points involved.

We mention the legal aspects of the matter here simply because they are typical of much of the thinking of the layman regarding this matter of insanity and because they demonstrate that hard and fast lines may not be drawn; that the question of sanity is vastly more complex than indicated by the answers to a few legal-sounding questions.

The other aspect of insanity that confuses most of us is that it seems not to be an all-or-none phenomenon. It is a little difficult for most of us to believe that a man can evidence some bizarre belief or delusions and yet, in all other respects, be quite normal. He may be an ideal husband or parent, a pillar of his community, a successful businessman and yet be dominated by the delusion that he is an apostle of some mystic being, that it is his mission to bring about some sweeping reforms. In the execution of this belief, in his attempt to establish new rules of behavior, it is not unlikely that he will run afoul of rules already in existence. It is then, but not until then, that he becomes a matter of public concern. It is then that we frown and stroke our chins and wonder "what got into this man." On the other hand, he may remain perfectly harmless. For example, a professor confessed to a former student that, for a whole year, he had believed he was a glass tube and that anyone could see what was going on inside of him. Yet, this delusion had no apparent effect upon his lectures, and no one had observed anything peculiar about him. It is in the hope of clearing up some of this bewilderment that we turn our attention to this chapter.

Causes of Abnormality

Insanity and heredity

One finds an enormous amount of confusion regarding the role of heredity in insanity. There is small wonder at this confusion, because psychologists and psychiatrists are themselves not perfectly agreed as to details. A general principle that bears remembering is: INSANITY AS A UNIT TRAIT IS NOT HEREDITARY; AND ALTHOUGH CERTAIN FORMS OF FEEBLE-MINDEDNESS APPEAR TO BE HEREDITARY, THE EXACT HEREDITARY PATTERN IS NOT KNOWN. Of course, we do find that the case histories of many insanities show a rather high incidence of psychopathic personalities in the ancestry. But this is no more clear-cut evidence that insanity is inherited than is the finding that musicians also have a rather high incidence of successful musicians in their ancestry. The fact that a parent or other relative of a patient has shown a pattern of insanity similar to that shown by the patient is not evidence that the pattern was inherited, any more than the preference of mother and daughter for olives is a sign that the daughter inherited the preference from her mother. As we shall see, when insanity develops, it is sometimes possible to predict the lines along which the development will occur if we but know the patterns of the behavior of some of the patient's associates. Some patients develop insanities similar to those exhibited by friends. Certainly, such a pattern is not inherited.

When we consider feeble-mindedness, however, the case for heredity is somewhat clearer. Some feeble-mindedness seems to be inherited; some is due to birth injury or prenatal influences; and some is caused by developments after birth. The particular hereditary pattern that feeble-mindedness follows has not been established. It is known as a *recessive* character; offspring will not appear feeble-minded unless the appropriate genes are possessed by both parents. Even when both parents possess the character in the genes, not all of the children will be feeble-minded. For this reason, the trait can and does "skip" certain generations, and is sometimes lost track of in

the maze of the complexities of the mechanisms of inheritance. The reason for this seems to be that feeble-mindedness is not a unit trait, like eye color, but depends upon a variety of gene combinations. That is why we do not expect a child to be either bright or feeble-minded. The gradation is continuous from one extreme to the other.

This distinction between the role of heredity in insanity and in feeble-mindedness is partially due to the fact that we are fairly sure of the structures involved in the latter. We are not yet sure as to the role of structure in insanity. To the extent that insanity can be traced to specific structures, we might say that it is inherited. We know that structure is inherited. Most insanities, however, are functional—that is, they are learned or acquired patterns of behavior. We know that acquired characters are not inherited. Heredity plays its part in the same sense that it does in the normal personality. Heredity and training determine how the person will cope with any adjustment problem.

Psychological causes of insanity

The question is not infrequently asked: "What caused this man to go insane?" Or, someone may say that a certain person "became insane as a result of the depression or an unfortunate love affair." The question calls for a simple answer, which it is impossible to give; and the other statement implies a cause much more direct and simple than actually exists. The study of abnormal behavior has led to the emphasis upon the concept of *multiple causation.* "MULTIPLE CAUSATION" MEANS THAT FOR EACH BIT OF BEHAVIOR, THERE ARE MANY—NOT JUST ONE—CAUSES OR ANTECEDENTS. This same principle applies to normal behavior. You may remember that when we discussed forgetting, emotion, thinking, and motivation, we continually emphasized the multiplicity of factors determining the final developments in each case. The same is true of abnormal behavior.

Usually, these causes are divided into two large groups. One group is made up of what are called *predisposing causes.* Heredity is one of these, as well as other facts in the background

and ancestry of the person in whom the abnormal behavior appears. The other group of causes is called *exciting causes.* These are events more or less in the immediate present to which we may trace subsequent developments rather directly. They consist of such phenomena as reversals, frustrations, disappointments, illnesses, and maladjustments. WE MAY SAY THAT NO INSANITY DEVELOPS UNLESS BOTH PREDISPOSING AND EXCITING CAUSES ARE PRESENT. This distinction will help us to understand why some individuals go insane, or exhibit abnormal symptoms under certain conditions, while others do not. An analogy may make the point clearer: If there has been no rain during the summer months, if there has been an abundance of foliage, and if a wooded area is unprotected, we may say that several predisposing causes have set the stage for a destructive conflagration. No forest fire will occur, however, unless an exciting cause—such as a lighted match, or cigarette, or lightning—is applied to dried underbrush and leaves. On the other hand, no amount of carelessness in the handling of matches and campfires will set fire to a wooded area that is green and moist or protected from fire. In the latter case, the exciting cause is present but the predisposing causes are absent. The analogy is not perfect, but it may help you understand why not all individuals will break under equal amounts of psychological pressure; why some individuals are capable of withstanding reversals, disappointments, and other disorganizing influences while others cannot.

Abnormality due to pathological conditions

We would expect distortions from a normal personality if there are marked pathological conditions. Tuberculosis, heart disease, or long and severe illness of any kind brings in its wake ineffective reaction patterns. If your friend does not measure up to par, you excuse him by saying that "he is suffering from the effects of the flu," "he isn't himself since his long illness." In more extreme cases, the abnormal behavior can be attributed directly to the deterioration of the brain. In syphilitic infection, the cortex of the brain may be destroyed in increasing amounts. In such cases, there is general deteriora-

tion of behavior, lowered intelligence, lowered moral standards, the onset of hallucinations, delusions, loss of memory, and so forth.

Old age is sometimes accompanied by *senile dementia.* With increasing age, all individuals become less efficient. Their reactions are slower; they lose interest in the things that occupy younger persons. But a relatively small number of the total population, because of the hardening of the cerebral arteries, deteriorate to "second childhood." *Retrograde amnesia* is the most common symptom. Recent events are not remembered, while patients still retain vivid memories of their childhood and youth. As the deterioration progresses, memory loss extends further back into child experiences. Hallucinations and delusions may also be present.

There is also a change in personality frequently observed in women at the time of the menopause. In extreme cases, melancholia and exaggerated fears may also develop.

All of these disorders have some easily traced structural basis. In some, the behavior disorders are directly due to the malfunctioning of certain structures; in others, the disorders are due to the individual's adjustment to his illness.

Manifestations of Insanity

Manic-depressive psychosis

If you should meet in a restaurant a man who was poorly dressed but who showed great cordiality, who told marvelous stories and then told you he owned all the railroads in the United States, you would suspect that he was "crazy." You might chance upon another man who was well dressed. After talking with him in a hotel lobby, he invites you to dinner. He tells you about his silver mines. You meet him again and become friends, although you know little about him. One day, he presents you with a stock certificate "because he likes you." Then you discover that he has no mines, but "thinks he has." One was easy to detect; the other has ruined the family finances and borrowed from the banks. Both men were *insane.* Both

exhibited high emotional tone or feeling of well-being, and both suffered from delusions of grandeur, of great wealth and great power. If, on the other hand, they had been very depressed and had told you that children were dying by the thousands, or that "the world is coming to an end and it will be awful," you would believe that they were ill and needed a doctor.

Such cases are classified as *manic-depressives.* They may alternate from one extreme to the other, or they may have periods of one phase alternating with periods of normal behavior. Physiological changes are at the basis of these shifts in behavior patterns, but they are of interest to the pyschologist because they are marked changes in personality and are closely related to those slight changes which you so often experience. Today, you feel on top of the world; everything looks promising. At some other time, you see everything through dark-colored glasses. Here again, the alternations of the manic-depressive is but an exaggeration of the same phenomenon observable in the behavior of all of us.

Hallucinations

In a recent issue of a popular picture magazine, there was a picture of a man walking in the streets of Amsterdam entirely nude, except for shoes and socks, and a hat and umbrella. It was stated that this was a protest against the German rationing of clothing and that the man was thrown into a concentration camp. As you read the daily newspaper, you will occasionally read an account similar to this in your own community. A man is arrested for appearing on the streets nude, or a woman disrobes in a public place. One suspects that the man in Amsterdam belonged in a hospital rather than in a concentration camp. Sometimes these persons exhibit confusion, and it is not possible to determine what instigated the behavior. Others are "commanded by voices." These *hallucinations,* or false interpretations of noises or things seen, dominate their behavior, just as you step out of the way of an approaching streetcar or answer the telephone. Sometimes you too hear voices or footsteps. Examination discloses that it was only the wind or a board creaking.

Paranoia

In some cases, it is possible to discover more clearly the personality characteristics that contribute to these marked deviations from the normal pattern. The following case [1] is a good example of the development of *paranoia,* the chief characteristic of which is consistency and apparent logic of the delusions:

We may call this man *X*. He was reported to have been "peculiar" as a boy. He never played with other boys without starting a fight. He was the originator of many plans that were never finished. He entered medical school, but did not finish the second term. Then, for six years, he worked for a manufacturer. One day, he wired his brother for $500 to buy a horse and carriage in order to compete for a young lady's attention. Then he threw it all up; he gave up the girl and quit his job because he "couldn't keep his mind on his work." He went to Manila and taught in a school for natives. Everybody there was against him because they thought him a "degenerate." Here was the first evidence of delusion of persecution. The knowledge of his own sex irregularities and his failure to succeed contributed to his imagining that others were talking about him.

When *X* returned to his home, he tried to interest several influential people in a project. The first one wore a Masonic emblem; so did the second. As he did not succeed in interesting any one in his scheme, he attributed the failure to the Masons. Then it was the Catholics. Always some person or some organization was responsible for his failure—never himself. Delusions of persecution often lead to delusions of grandeur. If you believe that your instructors have clubbed together to get you, and that they have influenced the President to do likewise, then you must be important to demand so much attention. So with *X*; he developed the delusion that he was commissioned to assassinate the members of the President's Cabinet.

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[1] Haines, T. H., "The Genesis of a Paranoic State," in *Journal of Abnormal Psychology* (1917), Vol. XI, pp. 368–396.

This is only one case, but it is worth considering. As a boy, this person had a bad start. He never faced reality for long. His habit of projecting his faults in others and "explaining" his failures extended until he became an institutional case. Whether proper training in childhood could have prevented this outcome, of course we do not know, but it is quite within reason to believe that it could.

Dementia praecox

A group of symptoms that should be of special interest to college students is the condition known as *dementia praecox,* or *schizophrenia.* As the name *praecox* implies, this type occurs early in life. The *dementia* is often more apparent than real, for there may be no deterioration in brain structure, as is evidenced by the fact that many recover and show no ill effect. The typical background is that of a "shut-in" personality. These individuals have usually been inclined to hold aloof from their associates. They keep their troubles to themselves. When their problems of adjustment become too great, they seem to lose interest in their surroundings. Decisions are difficult. Here is a second-year medical student who has been a laboratory assistant. Near the end of the year, he developed *aphasia,* or the inability to pronounce words correctly or in the correct order. When college closed, he did not go home, but sat on the porch of his rooming house all day, although he did go out to meals three times a day. It was fully a month before he could get started for home. This is a very simple case.

Some cases of dementia praecox are delusional, but their delusions are not so systematic as those of paranoia. Others manifest automatisms and negativisms. One continues to do whatever he gets started doing, such as walking around a chair all day. Another resists being made to stand up, and then resists being made to sit down again. Sometimes patients assume a catatonic posture, remaining in one position for hours or years. They are unreliable, may suddenly change from stupor to striking an attendant. In general, they appear indifferent and display no emotion.

As previously indicated, some of these patients recover;

others are cured by treatment; many live to old age. While many students present the early symptoms, most of them are able, with a little assistance, to make the necessary readjustment. Dementia praecox is not a matter of defective intelligence; that is why we find so many students suffering from it. Temporary ill-health and possible glandular irregularities, plus a rigorous social environment for which the individual was not prepared, contribute to confusion and general breakdown.

Neurotic Behavior

The term *neurosis* is applied to a variety of abnormal reactions which, because of their violence or peculiarity, are considered abnormal. They are not directly due to any physical abnormality. They are reaction patterns brought about by inability of the sufferer to cope with his problems. "Nervous breakdown," "nervous exhaustion," and "hysterical attacks" are among the more common names you are familiar with. Although they are not directly caused by organic disease, they may be contributing causes to heart disease, stomach ulcers, and many other organic diseases, because of the strain upon the heart and the reactions of the autonomic system, as we have seen in the case of violent or long-continued emotion.

We have seen that there are two ways in which we may respond to a problem situation: (1) we may attempt to solve our problem; or (2) if we have no ready response, we may become disorganized. The neuroses are extreme cases of the latter reaction. We might suspect, therefore, that the neurotic personality would show a history of faulty training. On the other hand, we may all be subject to neurosis if conditions become severe enough. The number of neuroses increases as living conditions become more severe, as, for example, during war or financial stress. A neurosis occurs when you meet a situation for which you are unprepared and to which you cannot make an adequate adjustment.

Take this case of a soldier in the First World War. After two weeks at the front, he was slightly wounded in the right shoulder. When the wound healed, he was unable to use his right arm. There was no evidence of any injury to the nerves

of this arm that would cause the partial paralysis. But this history showed that, several years ago, he had fallen off a hay wagon on his father's farm and injured his right arm. As a result, he had been unable to do any work for the rest of the summer. It was suspected at that time that he did not like farm work and that he exaggerated the injury. When he was wounded, he also fell on this arm. We do not know for sure, but the evidence pointed to a relationship between these two instances. He had acquired this conditioned-response behavior.

It is not necessary to go to war casualties to find cases like this. Here is a college student, a senior, who stutters on occasion; she frequently suffers from severe headaches, particularly near the end of the college term. She knows that there is something wrong with her adjustment and comes in for advice. Her story is typical—a doting mother who is dominated by the father. The latter has always been very severe and unreasonable. The girl has never been able to make her own choices; and when she has failed to do a job just as her father wanted it done, he has given vent to violent swearing. The girl knows that these conditions at home have had something to do with her present condition, but she does not improve. Her father has died, and she is now on her own. The early training seems too strong. She is meeting the ordinary difficulties that most students take in their stride, but they are too severe for this girl.

Experimentally produced neurosis

There has been a great amount of speculation and theorizing about neurotic behavior, particularly in the more extreme forms. The abnormal has always tended to be shrouded in mystery. Recently, however, some experimental attacks have been made on the problem. The thought is that, if we could produce a neurosis under experimental conditions, with all the necessary controls, we would know what causes it; and we would then be in a better position to correct the conditions or to treat the patient. Of course, we could not do this with human subjects, so that the psychologist has resorted to experimentation with animals. Perhaps this would not have

occurred to experimenters had not Pavlov, the Russian physiologist who used the conditioned-response technique, observed the behavior of one of his dogs. He had trained the dog to discriminate between a circle and an elipse. Then he widened the elipse to determine how fine a discrimination the dog could make. As the elipse approached the proportions of the circle, the dog finally was unable to make the right choice and was consequently punished each time he made the wrong choice. At the same time, Pavlov noticed that this dog, formerly friendly, now became ugly and fought with the other dogs in his quarters.

The same general type of experiment has been used with rats.[2] They were first trained to jump from a small platform to either of two openings. A light door closed each opening, and on each door was a geometric figure—for example, a black circle on a white ground or a white circle on a black ground. The rat might be required to select the black circle. In this case, if he jumped to the black circle, the door could be pushed open and food obtained. If he jumped to the white circle, the door would be locked, and the rat would fall into a cloth tray below (Figure 111). Finally, there was no right response, no correct solution. Both doors would be locked. In order to ensure jumping, a jet of air was blown on the animal. After many trials, two types of responses developed:

1. One rat would simply jump against the closed doors, with no apparent choice.

2. Another rat, after a few trials, would jump from the platform, hop about the room, and end in a sort of stupor or catatonic state, resembling many human subjects under conditions that prove too difficult for them. The animal could be placed in any position by the experimenter—on its back, legs flexed or extended, suspended by its tail, and so forth (Figure 112). This presented quite a different picture from a similar manipulation of a normal rat.

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[2] Maier, N. R. F., *Studies in Abnormal Behavior in the Rat* (New York: Harper and Brothers, 1939), p. 81; *Comparative Psychology Monographs* No. 1 (1940), Vol. XVI, p. 30; *Journal of Experimental Psychology* (1940), Vol. XXVI, pp. 521–546, and Vol. XXVII, pp. 369–393; and *Journal of Comparative Psychology* (1940), Vol. XXX, pp. 413–418.

We have, then, two quite different responses to an unsolvable problem situation: one rat merely jumps aimlessly at the wall or the doors, while the other continues to work on the problem until it becomes completely disorganized.

Experiments are now in progress in an effort to discover what type of early training is conducive to neurotic behavior. The

FIGURE 111.—APPARATUS. The rat is trained to jump at cards placed in the windows of the apparatus. The card with a black circle on a white background falls when struck and permits the rat to reach food behind the card. (*From Maier.*)

problem may be stated in the form of a question: "Is it possible to increase the resistance to neurotic behavior by a social background providing training in dominance over the environment and by emphasizing the security aspects of the environment outside the experimental situation? [3] A sheep and a dog were used as subjects in another experiment. The sheep was given

[3] Curtis, Quin F., "Environmental Background and Resistance to Conflict in the Dog and Sheep," in *Psychology Bulletin* (1941), Vol. XXVIII, p. 578.

training in competent, independent adjustment to various natural environments from birth. The dog's environment was made "socially secure" by providing a stable relationship with the experimenter for two years. Later, the dog's environment was rendered insecure by various means, including unpredictable friendly and harsh attitudes, without reference to the dog's

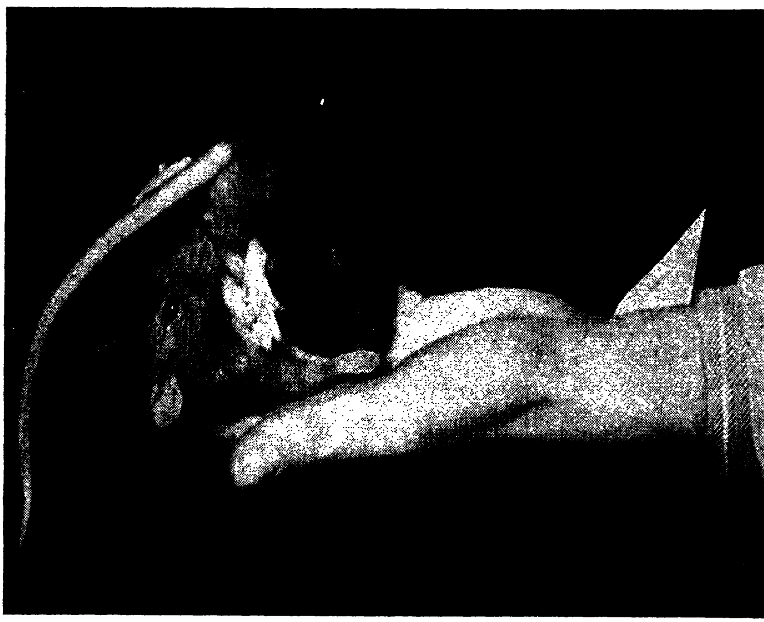

FIGURE 112.—PASSIVE PHASE WITH RAT ROLLED UP INTO A BALL. A rat may remain in this position for over 8 minutes. (*From "Studies of Abnormal Behavior in the Rat," by Norman R. F. Maier. Harper and Brothers, 1939.*)

conduct. It was found that both animals' resistance was strongly affected by the early training and by the stresses that occurred outside the laboratory-test routine. Some psychologists object that these neuroses induced in animals are not true neuroses, but we are not concerned here with the definition of the term. Under specific laboratory conditions, animals manifest many of the symptoms exhibited by persons who are diagnosed as "neurotic."

Variety of neurotic symptoms

We have touched upon some behavior patterns that may result from lack of ability to meet a problem situation or conflict. Stuttering, headaches, and general ill-health are only a few of the more common responses that the "weak personality" learns to substitute for a direct attack upon his disagreeable problems. Many of the physician's patients do not come to his office because of any organic disease. Disharmony in the home sends many women to the doctor for treatment of imaginary ills. Men who do not get along well in their business or profession add to the group. A common error in the treatment of these cases is to treat the symptoms, forgetting that such treatment does nothing about the underlying causes of the disorder. The best treatment for these cases requires an investigation of the origin of the trouble, and then the proper readjustment of those most vitally concerned. This procedure is more psychological than medical, and requires special training and experience for successful treatment.

More extreme cases find their way to the psychiatrist, the physician specifically trained to deal with them. Among these patients are found a variety of fantastic phenomena. Here is a woman whose arm is insensitive from the wrist halfway to the elbow. This anesthetic area does not conform to the nerve distribution, so that you suspect *hysterical anesthesia.* Like the soldier with the paralyzed arm, it was found that something had happened to this arm at a time when the woman was undergoing an emotional shock. Something rested on the arm, rendering it "asleep." Later, this developed into a relatively permanent *anesthesia.* Some patients are blind or deaf, anosmic or insensitive to odors. Others cannot recall certain events in their lives, although it can be shown that these events are not actually forgotten. Some of these amnesias assume a spectacular form that deserve special description.

Dissociated personality

When amnesia becomes very pronounced, a person may behave so differently on different occasions that he appears to be

two persons in one body. This has led to the unfortunate concept of dual or multiple personalities. You are familiar with *Dr. Jekyll and Mr. Hyde.* There are many authentic cases equally impressive.

For example, there is the case of Miss *B,* who at various times exhibited several "personalities."[4] The most pronounced were B_1 and B_4. When Dr. Prince first observed this young woman, B_1 was dominant. She appeared refined, educated, and extremely modest. It was very difficult for her to talk about herself, even to her doctor. One day, while she was in the doctor's office, her whole expression changed. She grimaced like a vulgar street urchin and talked flippantly, using a great deal of slang. She claimed to know all about B_1, even her thoughts, except when B_1 read French, which she could not understand. She said B_1 worked too hard and "mooned" a great deal, while she (B_3) wanted to have a good time. When B_1 dominated, she knew nothing of B_3, only that there were gaps in her life that she could not account for. B_3 did not feel fatigue, and would go for long walks. B_1 would find herself in the country, greatly fatigued and not knowing how she got there. As you read on in this entertaining story, you begin to feel that there are these real personalities. Who is the real Miss *B*? Is it B_1, B_2, B_3, or B_4? In the end, it proved to be not any one of these but all of them. They represented only some of the characteristics of the total personality.

Consider your own characteristics: You are modest, proud, religious; you have goals; you enjoy a boisterous good time; you love and hate. But your modesty is restrained by your sense of fitness of situations. You can be frank when it is appropriate. Your piety or religious fervor is likewise restrained within bounds. All of your response patterns are fairly integrated with each other, so that you do not go to extremes. In other words, you remember what you did yesterday or a moment before. But in this young woman's case, an emotional situation had so completely disrupted her habit systems that they formed "clusters" of response patterns, with

[4] Prince, Morton, *The Dissociation of a Personality* (New York: Longmans, Green and Company, 1910).

no specific connections with each other. The same phenomenon is present to a less marked degree when certain patterns of your own adjustment dominate everything you do. During these periods, you may be referred to as a "beast" or "saint," or in some other terms that show cleavages in your personality. You may even think of your "better self" or wonder "whatever possessed" you to make you do certain things. The difference between these everyday occurrences in your own behavior and those of the cases we have been describing is that the break is not as complete or as sudden or with as lasting effects.

Summary

We have presented a very sketchy outline of the abnormal personality. Our intention has not been to "explain" all the phenomena that occur. The more complete description and interpretation must be left for courses in abnormal psychology, psychiatry, and neurology.

We wish merely to emphasize that the abnormal, like the normal, personality is conditioned upon early training and adjustment. The distinguishing feature of the abnormal is the exaggeration of adjustment peculiarities always present in the normal. A second point to reconsider is that a person may be abnormal or insane in one respect and perfectly normal in other respects. Do not trust the argument that so-and-so is incompetent because he is a sex pervert. Equally important is the understanding of the abnormalities. Do not assume, because so-and-so is a great man or proves capable in his chosen field, that he cannot be insane.

Test Items for Review

These items are designed to help the student check his progress in mastering the course. Each item should be read carefully and the answer written on a separate sheet. When a list has been completed, the text should be consulted again to determine whether your answers are correct. Study particularly your incorrect items. Try to determine why you answered them as you did. Some items are to be marked simply "true" or "false." In other cases several choices are given ("multiple choice"). Here you should select the *best* statement because two or more statements may be true, but one is designed to be better than either of the others. If an item calls for a word to complete the statement or for a short paragraph, *write* the word or paragraph. Do not trust yourself to an oral statement or to the assumption that you could write the answer if you were called upon to do so.

CHAPTER 1

True-false items:

1. Claustrophobia is a good explanation of a person's fear of closed places.

2. An experiment which verifies the findings of another investigator is an unnecessary expenditure of energy.

3. The most important factor in the scientific method is that the observer be trained to distinguish what he observes from what he would like to infer.

4. The best explanation is a complete description of the related events.

5. Scientific proof requires a complete statement of all of the conditions surrounding an event.

6. A scientific theory is a final statement or explanation.

7. The accuracy of careful observations is further increased by the use of mathematics.

8. Many common beliefs regarding human nature are not verified when we consider the so-called negative cases.

9. Personal phenomena which cannot be experienced in some way by others is of little interest to the scientist.

10. The beginner's learning of psychology goes along rapidly inasmuch as he already knows many popular notions, such as: "Redheads have fiery tempers."

11. Apparatus is used in an experiment to help the scientist in being as objective as possible.

12. We can improve our study habits only by practicing good methods of study.

13. The science of psychology began before astronomy because of man's great interest in himself.

14. The difference between psychological laws and most common-sense statements is that the former is based on controlled observation.

15. Some hypotheses are called working hypotheses because they are known to work in describing all of the known facts.

16. The use of statistics does not aid us in our interpretations if we have made considerable effort to obtain well-controlled observations.

17. In the history of science we find that it has been easiest to dislodge those explanations which are concerned with very personal attitudes and beliefs.

18. Inferences arising from the conclusions of an experiment often serve as further hypotheses.

19. If all of the available information on a given theory agrees with it reasonably well, it is considered to be a hypothesis.

20. A good scientist will form a theory and then find facts to support it.

Arrange the following steps of a scientific experiment in a satisfactory order of procedure.

21. Statistical treatment.

22. Isolation and control of the variables.

23. Formulation of generalization and interpretations.

24. Statement of the working hypothesis.

25. Collection of the data.

Multiple-choice items:

26. We develop most of our misconceptions because (1. we find that they describe events accurately; 2. we enjoy being fooled within certain limits; 3. we are taught them before we are able to examine them critically; 4. we are taught them by ignorant teachers).

Completion items:

27. When all of a great deal of scientific evidence upholds a hypothesis, the latter becomes: ________.

28. The interpretation of a group of related facts is called: ________.

29. A reasonable, tentative guess regarding some factual information is called: ________.

CHAPTER 2

True-false items:

1. In the evolution of man the development of an upright position was probably an advantage to man because it left his hands free for other purposes.

2. If a chimpanzee had man's intelligence and were given sufficient training, it could probably learn to manipulate tools and do skilled tasks with the hands as well as man can.

3. Though different neurones perform different functions, there is little variation in the structure of the various neurones.

4. The function of the neurone is the carrying of the nervous impulse.

5. The greatest difference in the relative size of parts of the brain of man and his near relatives is in the cerebrum.

6. Most "tastes" are a combination of taste and smell.

7. The fact that man has superior brain development is an adequate explanation of the development of a language in man.

8. The eye is a receptor while a muscle is an effector.

9. Most of our simple everyday responses involve three or four neurones, one of which connects with the brain.

10. The evolutionary chart indicates that man's process of development has been a continuation from the ape.

11. As psychologists, we are seldom dealing with isolated pathways in the nervous system but rather with a total pattern of neural activity.

12. There is no essential difference between the brain and spinal cord except that the brain is more complex in interconnections of neurones.

13. While it is true that every response is the result of a stimulus, it is not true that every stimulus leads to a response.

14. While we do have at least eight senses, only five of them are basic.

15. When we say that a muscle is stimulated, we mean that it is contracting.

16. The behavior of lower animals, but not of man, may be explained in terms of muscles, glands, and nervous system.

17. The speed of reaction is approximately the same in smooth and striped muscles.

18. A stimulating situation involves simultaneous functioning of many receptors.

19. Human beings can hear and see only a fraction of the lights and sounds around them.

20. If it were possible to isolate and determine the function of each single nerve pattern, the psychologist would be able to list every possible type of human behavior.

21. The various surfaces of the retina have equal acuity.

The subject of psychology is fundamentally concerned with:

22. How to eliminate erroneous conclusions about human behavior.

23. How man gets along in his social world because man is above all else a social animal.

24. How to succeed in life through adequate use of the power of suggestion on others.

25. How to interpret life in a fashion which will satisfy our beliefs as to what man's nature comprises.

26. How the infant grows up to become an adult.

Multiple-choice items:

27. A muscular contraction, glandular secretion, or any other activity of an organism which results from stimulation: (1. sensation; 2. stimulus; 3. response; 4. feelings; 5. emotion).

28. A muscular sense used in discrimination of movement: (1. equilibrium; 2. kinesthesis; 3. synesthesis; 4. autonomic; 5. endocrine).

29. If, in a perfectly quiet room, a sleeping dog suddenly moves his legs, we can safely infer that (1. there was no stimulus for that response; 2. he is probably dreaming; 3. the stimulus probably originated within his body; 4. he is partially awake).

30. The best reason for studying psychology is to learn how (1. to recognize a psychological fakir; 2. to write a better advertisement; 3. to study more effectively; 4. to control and predict behavior).

Completion items:

31. The receptor which functions in the discrimination of rotation of the body and other disturbances of posture: ________ ________ (two words).

32. Most of the neural overgrowth of man is in the brain and spinal cord, which comprise the ——— nervous system.

33. Any physical change which acts upon a receptor is called: ———.

34. A gland which delivers its secretion directly to the blood is said to be ———.

35. The part of the cerebrum which in man is relatively most highly developed is the ——— ——— (two words).

36. The mechanism of the body whose chief function is the transmission of impulses is the ———; the integration of the body is accomplished through the ——— ——— (two words).

37. The technical word for the sense of taste is ———; for the sense of smell, ———.

38. In order to see at night we use special visual receptors called ———.

39. The feelings of hunger and thirst are classed as ——— sensations.

40. The part of the cochlea which supports the actual sense cells for hearing is the ———.

Essay questions:

41. What are the characteristics of living organisms?

42. In what respects is man superior to the apes? Indicate the physical structures responsible for his superiority.

CHAPTER 3

True-false items:

1. It has been shown that musical aptitude is not an inherited characteristic.

2. Our intelligence tests rest upon the belief that all children have about an equal opportunity to experience common life situations.

3. The first tests of intelligence were introduced by Binet in the early eighteenth century.

4. Most intelligence tests have drawn the great majority of their items from a few restricted fields of information.

5. If the child is unwilling to take an intelligence test, it is up to the tester to compel the child to cooperate.

6. If you know the environment from which the child comes, you are permitted to be somewhat more lenient in the scoring of his intelligence test.

7. A child blind from birth would not have an opportunity to show his true intellectual ability on a test of the Binet type.

8. If anyone should practice tennis long hours with a good professional, he would have an excellent chance of becoming a top-ranking national player.

9. There is a special chromosome which determines sex.

10. Two-egg twins are an ideal source of subjects in an experiment on heredity because each pair has the same hereditary factors.

11. When the environment of two individuals is identical, any difference in intelligence between the two is solely the result of heredity.

12. Both intelligence and musical ability are probably inherited through several genes.

13. Both parents play an equal part in determining the inheritance of their children.

14. Life starts whenever male and female germ cells unite.

15. Genes are arranged in pairs except for those which are dominant.

16. Environmental effects which act upon your body cells may affect the inheritance of your children.

17. The embryo receives its food supply through the fallopian tube.

18. Attainment refers to the combined effects of both heredity and environment, but intelligence is the effect of heredity.

19. Arrange the following from high to low according to the relative amount in which heredity probably plays a part:

a. generosity
b. ability to memorize a poem
c. shape of the nose
d. skill at playing a violin concerto

Multiple-choice items:

20. Binet (1. made the American revision of the original scale; 2. made up the first test of intelligence; 3. studied aboriginal intelligence; 4. made the first group intelligence test).

21. Mental age is (1. the intelligence of the examinee; 2. the ratio of intelligence to chronological age; 3. the measure of test performance).

22. If it is true that the I.Q. remains constant, a child with an I.Q. of 125 at four years of age will have an M.A. at twelve years of (1. 14; 2. 15; 3. 16; 4. 17).

23. In the last analysis the transmission of inherited factors is accomplished by the (1. sperm; 2. chromosome; 3. fertilized ovum; 4. gene).

Completion items:

24. The number of chromosomes found in a human fertilized ovum is

25. The correct formula for calculating the I.Q. from M.A. and C.A. is ———.

Essay question:

26. What traits do you believe you inherited from your father or mother? What are the possibilities that these were learned by living with your parents?

CHAPTER 4

True-false items:

1. Considerable learning is required before an infant is able to make random responses.

2. There is much behavior that is not dependent upon structure.

3. It is necessary for every child to go through a long period of "baby talk" before acquiring an adequate use of language.

4. When a person sees some appetizing food, his salivary flow will increase. This is an illustration of the conditioned reflex.

5. All the reflexive responses of an infant are unco-ordinated at birth.

6. The simplest type of behavior is generally described as a reflex, but this reflex depends not only upon a specific stimulus but also upon the total activity of the organism at the time of stimulation.

7. The behavior of the "wild boy of Aveyron" may be described as attributable to both heredity and environment.

8. Maturation alone can account for the development of some limited patterns of behavior.

9. The five stages of development in the amblystoma were correlated with increased complexity of the nervous structure.

10. Amblystoma which have previously learned to swim take less time to swim after removal from chloretone than do mature amblystoma which have never swum before.

11. If chickens are prevented from pecking for a long time while maturing, they never learn to peck because their structure for pecking has not developed adequately.

12. Chicks which have been prevented from pecking for three days learn more rapidly to peck than do those chickens of the same age whose pecking has proceeded normally.

13. Isabelle's poor performance on her first testing was due to poor environment, but Anna's was due to bad heredity.

14. Maturation of the physical structures of human beings may proceed in the absence of any practice involving those structures.

15. Social immaturity may result from either lack of growth or lack of learning.

16. There is evidence to show that learning begins at birth.

17. The number of repetitions which occur in the conditioning process has greater effect than the degree of the organization.

18. Our knowledge of learned material may increase with the passage of time even though we may forget the exact words.

19. Measures of achievement for people of various ages indicate that achievement increases slightly until the early forties.

20. The age of greatest production varies with the field of endeavor.

21. The fact that older men hold positions of authority is evidence that they are best fitted for those jobs.

Multiple-choice items:

22. The best explanation of a child's acquiring the skill of walking is: (1. maturation is the only important factor; 2. it is primarily a learned skill; 3. it is combination of both instinct and proper training by parent; 4. learning is of great importance after certain levels of maturation have been reached).

23. Your ability to answer these questions is most accurately said to be the result of your (1. knowledge; 2. learning; 3. skill; 4. maturation).

Completion items:

24. The ability to perform certain acts is called ________.

25. In the illustration of the dog salivating at the sound of a bell, we speak of the bell as the ________ stimulus.

Essay question:

26. What are your deficiencies? Are they due to your age or lack of training? What can you do about the situation?

CHAPTER 5

True-false items:

1. When using a reward as an incentive, it sometimes loses its effectiveness unless it is increased progressively.

2. Giving bonuses to old employees speeds up their production.

3. Learning is only occasionally influenced by the motivation furnished by the situation in which the learning takes place.

4. An army's use of medals of honor is founded upon rather sound psychological theory.

5. The type of response an organism makes is relatively independent of the condition of the organism at that time, but is dependent upon its past experiences.

6. Rivalry for grades or for extracurricular recognition is an example of the operation of the motive for pre-eminence.

7. Economists have offered much evidence to show that man's behavior is directed completely by the urge for more worldly goods.

8. Conformity is a pattern of basic urges which are found innately in all human beings.

9. Most of our motives tend to lead us in the same direction, as in the case of conformity and pre-eminence.

10. Our level of aspiration depends upon personal factors and is little influenced by what others in our group can do.

11. Even in group projects it is beneficial to give some sort of individual rewards.

12. Co-operation is a distinctly human trait, for it has been shown that we cannot train monkeys to co-operate.

13. Co-operation is a stronger motive than competition because it is constantly being taught in the schools.

14. It has been shown that the worker's attitude is as important a determinant of his work as are his working conditions.

15. The quality of work in factories may be improved by merely letting the employees know how well they are doing.

16. One's habits of work may be so strong that the amount of work is little influenced by the offer of extra pay.

17. In deciding on what motivation to use on employees, it is important to consider both the factor of immediacy of reward and its appropriateness.

18. Morale refers to the feeling that our cause is the most righteous one.

19. Even the most interesting work may be monotonous.

20. Praise is equally effective at all ages.

21. To get the best results we should praise the poor students and reprove the best students.

22. If we use several incentives, their total effect will not vary much from day to day.

23. Arrange the following in the order in which workers prefer them: (1. good hours; 2. opportunity to use their ideas; 3. steady work; 4. high pay).

Completion items:

24. When we do those things which make us happy and avoid unpleasant events, we are behaving in line with the doctrine of ———.

25. In a study of preferences where each item is compared with every other item, the method is called the method of ——— ——— (two words).

Essay question:

26. How could the morale of this course be improved? Be specific in your recommendations.

CHAPTER 6

True-false items:

1. There is evidence to show that adults choose a perfectly balanced diet when they allow their preferences and appetites to direct them.

2. It has been demonstrated that there is an increase in general bodily activity with an increase in hunger contractions of the stomach.

3. The obstruction box is an apparatus used in testing the conditioned reflex.

4. Bodily temperature is not a fundamental drive as is hunger and sex.

5. A drive includes those physiological tensions which lead to some form of increased activity.

6. Socially derived motives are usually much weaker than the basic drives.

7. Such motives as altruism and unselfishness might be traced back to simple physiological drives except for the fact that the socialization of motives obscures the relationship.

8. All behavior is initiated by changes either in the external environment or changes in the organism itself.

9. The value of a goal can be described adequately in terms of the goal itself.

10. In an infant a drive results in more or less random behavior.

11. Hunger and thirst reach their maximal strength in about the same number of days.

12. Activity occurring at any one moment is probably the result of a single drive.

13. The thirst drive is largely psychological in that we feel thirsty whenever we realize that it has been some time since we have had water.

14. It is characteristic of the thirst and sex drives that they have a specific locale of stimulation.

15. Habits are characteristic ways of behaving and cannot be considered as motivating forces.

16. It is characteristic of man but not lower animals that he can learn to react to symbols as though to an immediate goal.

17. The term "instinct" is helpful in describing, though not explaining, the behavior of lower animals.

18. The attainment of the goal is accompanied by a reduction in tension.

Multiple-choice item:

19. In the male rat the strongest drive is (1. sex; 2. symbolism; 3. competition; 4. hunger).

Completion items:

20. The physiological drive which has a characteristically slow development is the ________ drive.

21. The desire for some specific food, such as a crisp apple, is called: ________.

22. In the case of a student who wishes to write a long term paper, speaking in terms of motivation, the many hours of work required we call the ________.

23. Men who suddenly retire after many years of active work find themselves restless because of the motivation due to their ________.

24. The eating of food after a period of deprivation is called a ________ response.

Essay questions:

25. Note your periods of hunger for a day. Try to observe the intensity and duration of these periods. Are you sometimes hungry for a short time and then get over it without eating?

26. Do certain articles of food appeal to you more at one time than another? How can you account for this variation?

CHAPTER 7

True-false items:

1. Everyone feels inferior to some extent, yet not everyone compensates for such feelings.

2. Daydreaming is very undesirable behavior and should always be discouraged.

3. Hallucinations and delusions are two names for the same type of behavior.

4. Rationalizing, projection, delusions, feelings of inferiority and compensation are all possible ways of resolving a conflict in motives.

5. If we meet with frequent obstruction to the satisfaction of our motives, or with persistent interference with a dominant motive, we may develop a feeling of inadequacy in life situations which in time seems to dominate most of our behavior.

6. Projection is more the outgrowth of organic requirements than of social requirements.

7. There are only a few differences in the things about which men and women daydream.

8. If we could decrease the amount of rationalization and identification, we would decrease the amount of maladjustment.

9. Fatigue resulting from indecision is merely a rationalization.

10. Psychologists try to evaluate the various adjustments in order to describe them better.

11. We should seek to decrease the amount of motivational conflict among factory workers because conflict tends to increase the number of accidents.

12. People who feel inferior welcome criticism, for in this way they can improve themselves.

13. The adjustments to conflict discussed in this chapter are common to many normal people, but are quite different from those that appear in abnormal people.

Multiple-choice items:

14. The greatest harm from phantasy is that it (1. seems abnormal; 2. does not create energies; 3. dulls the emotions; 4. does not lead to action).

15. A mother who gets a great deal of satisfaction from her daughter's social successes illustrates the mechanism of (1. projection; 2. identification; 3. delusion; 4. rationalization).

16. A mental conflict is best described as (1. incomplete understanding of the situation; 2. the blocking of a persistent motive; 3. the feeling that you "must do" something in particular; 4. the effect of ordinary conditioning).

17. Being "touchy" or "hypersensitive" is a mild form of (1. rationalization; 2. conflict; 3. compensation; 4. delusion of reference).

18. Many persons find themselves in difficulty because they (1. refuse to recognize any but commendable motives; 2. attempt to integrate their motives; 3. try to understand their motives; 4. discuss their problems with too many other people).

19. Conflicts between motives probably are best resolved by (1. imaginary achievement of unusual actions; 2. formation of a major purpose on a practical rather than a fantastic basis; 3. denying their existence; 4. building up reasons for behaving according to one motive).

Completion items:

20. Excusing oneself for getting a poor grade on an objective test because one had a minor headache is an example of ________.

21. Imagining that one is being talked about by a group of bystanders is an idea of ________.

22. A man who becomes an orator after possessing a pronounced speech defect illustrates the mechanism of ________.

23. Our goal in living should be to form a well-integrated pattern of motive with a minimum of ________.

24. When we make a choice instead of talking about "will power," we should use the words ________ ________ (two words).

25. False beliefs which often develop from projection are called ________.

Essay question:

26. Describe a situation in which you recently made a choice between two motives. Try to state all the factors that determined your choice.

CHAPTER 8

True-false items:

1. Many of the physiological changes which occur during increased physical exercise are similar to those which occur during an emotion.

2. Systolic pressure refers to the pressure exerted upon the lungs during a rapid inspiration of air.

3. One of the results of the action of the sympathetic system is the slowing down of the digestive processes and the throwing of the blood supply to the skeletal muscles.

4. Individuals lose their tempers quickly because the autonomic nervous system functions more rapidly than the skeletal system.

5. Among the components of the emotional state are rather primitive types of responses.

6. Lie detectors have been demonstrated to give practically perfect results.

7. When an emotionally exciting object is presented with one not emotionally exciting, the latter may later arouse the same reactions as the former.

8. Whether or not a child becomes easily frightened is dependent upon the way he is trained.

9. Emotions can be easily distinguished by variations in the organic responses which accompany them.

10. From the viewpoint of the child, temper tantrums may often become adjustive modes of response.

11. The sacral and the sympathetic divisions of the autonomic nervous system affect the body in opposite ways.

12. The cranial section of the autonomic nervous system prepares the organism for emergency situations.

13. Cannon produced rhythmic contractions in the digestive system of the cat by an injection of adrenalin as well as by the presence of a dog.

14. A sudden but temporary rise in blood pressure proves that the person in question was partly or entirely disorganized during that time.

15. The galvanic skin reflex is based upon the fact that the body contains slightly more electricity during an emotion.

16. The galvanic skin reflex has been suggested as a possible indicator of emotion even when overt behavior betrays no emotion.

17. Inasmuch as we are prepared for an emergency during an emotional situation, our ability to observe becomes greater.

18. In most cases we find that the I/E ratio decreases during emotion.

19. Feelings are not only milder than emotions but have different components.

20. Inasmuch as the activities of the autonomic nervous system are self-ruling, the name given to this nervous system is quite proper.

21. The development of emotional maturity is indicated by the increase in the number of situations in which organized behavior appears.

Multiple-choice item:

22. The part of the central nervous system which serves during a highly emotional situation is the (1. cerebellum; 2. cortex; 3. hypothalamus; 4. lower spinal cord).

Completion items:

23. Stimulation of the ________ gland produces the same reaction for a long period of time as do the sympathetic nerves for a short time.

24. The glands of internal secretion are also known as ________ glands.

25. To measure blood pressure we use a ________.

26. To measure the galvanic skin reflex we use a ________.

27. To measure respiratory change we use a ________.

28. The one word you should chiefly associate with emotional behavior is ________.

Essay question:

29. Describe a case of extreme anger in yourself or another person. What were the circumstances? How was the emotion manifest? Why might you at another time not have been angry in a similar situation?

CHAPTER 9

True-false items:

1. Fear arises when we know enough to recognize the danger in a stimulus but do not have an adequate response to the situation.

2. Individuals who have phobias are usually aware of the original experience which conditioned the fear.

3. Avoiding the feared object is a better method of treatment than is developing familiarity with the object.

4. Emotional reaction may be delayed so that a person meets the situation satisfactorily and then shows overt emotionality after the crisis is over.

5. When such behavior as love becomes systematic and organized with reference to some object or person, we should not speak of it as an emotion.

6. Psychology has succeeded in reducing the novelist's list of many different emotions to the fundamental six emotions now known to be basic for all shades of human behavior.

7. Often an emotional state is aroused when there is a conflict between two opposing responses.

8. Worry and anger may arise from frustrating situations, but in the case of anger there is a decided increase in activity.

9. In some situations you become quite angry even though you can respond adequately at the time.

10. Though the pattern of physiological changes does not indicate the particular emotion being experienced, it does tell us fairly accurately whether the emotion is pleasant or unpleasant.

11. Not all of our fears are disorganized responses.

12. The problem of emotions is not so much one of controlling them as of preventing them.

13. Even though the eyes of a person are not very helpful in judging emotion, they are most often used in making our judgments.

14. Photographs taken during a real emotional situation are quite helpful in making judgments concerning emotion inasmuch as there are conventional ways of expressing all our emotions.

15. One of the difficulties with emotions is that they tend to decrease the amount of our activities.

16. "Too much of a good thing may be bad" applies also to pleasant emotions.

17. The same situation may be beneficially motivating to one person and quite disorganizing to another.

18. Adults have more grief than children and usually grieve longer.

19. We are more relieved from unhappy situations by avoiding them than by trying to handle them in a straightforward manner.

20. Vacations are most helpful if they involve activities for which the individual has ready responses.

21. In a situation involving anger it is best to make an adjustment as soon as possible.

22. Pleasant emotions are usually milder than unpleasant emotions.

23. In the case of both fear and worry the best way to eliminate them is to try to understand their cause.

24. The "nervous breakdown" is often accompanied by physical ailments which are the result of emotional maladjustment.

Completion items:

25. A fear which readily appears and has a widespread effect upon the organism is called a ________.

26. If the individual's adjustment to a situation is to adopt childlike responses, we say that he has ________.

Essay questions:

27. A dignified lawyer enjoys an occasional hunting trip, cooking his own meals over a campfire, sleeping on the ground, wearing dirty clothes. Why does he enjoy such primitive living?

28. What is meant by the statement: "When there is fire in your heart, there is smoke in your eyes"?

CHAPTER 10

True-false items:

1. Emotion and attention exemplify contrasting integrations of behavior.

2. Effort in maintaining a given postural adjustment is describable in terms of tensions resulting from the conflict of antagonistic muscular patterns.

3. The duration of adjustment to a single stimulus under conditions of concentrated attention is about five or six minutes—a time much shorter than most people suspect.

4. Control of the behavior of others is possible when either the sources of stimulation are reduced or the range of action is restricted.

5. Heredity appears to exert no influence in determining the particular adjustment of the moment.

6. Certain conditions of muscular tension and respiratory and circulatory changes appear to be more or less universal components of the act of attending.

7. While it is true that attention refers to the facilitation of appropriate responses, the term does not include the inhibition of inappropriate behavior.

8. "Preoccupation" usually refers to attention to some part of the environment other than the part not attended to.

9. The range of attention is partly determined by the degree of organization of the items observed.

10. Weak-willed people are more readily hypnotized than others.

11. Subjective feelings of fatigue are so related to output that if we know how tired the worker "feels," we can predict the approximate level of his output.

12. A high degree of adjustment to one aspect of the environment will result in interference with the adjustment and response to other parts of the environment.

13. A review of the evidence leads us to the generalization that hypnosis is a special kind of suggestion phenomenon.

14. The increased tonus during attention adequately explains the functioning of posture.

15. Children cannot be hypnotized because their attention cannot be restricted for an adequate period.

16. "Cocking" your head to hear better some slight noise is an example of a secondary movement of attention.

17. People who react to verbal suggestions generally are suggestible to most other stimuli.

18. Inasmuch as fatigue increases the amount of blocking, we are able to do less work when tired.

19. We are most productive in the early morning, decreasing toward noon; after lunch we are refreshed and return to the morning's high production, decreasing during the afternoon.

20. Some individuals would be so distracted by the quiet of the Maine woods that they would be unable to work efficiently.

21. Extraneous stimuli, instead of distracting, may spur the individual to do more work, although at the expense of much more energy.

22. Under hypnosis the subject retains all of his normal inhibitions.

23. An individual can appear to do two things at once by rapidly shifting his attention.

24. The hypnotized person does not feel pain because the activity of the sense organs is largely inhibited.

25. A small advertisement which appeals to the reader's interest may be more attention-getting than some much larger advertisements.

Completion items:

26. The total adjustment of the organism which facilitates the reception of stimuli and the appropriate response is called ________.

27. The relation between two or more people which facilitates co-operation and understanding is called ________.

Essay question:

28. Select the course in high school or college that you have found most interesting or profitable, and another course that you disliked or thought that you got little out of. Analyze the "environmental" and "personal" factors in each case. To what extent was the course and instructor responsible for the difference and to what extent do you find that you were responsible?

CHAPTER 11

True-false items:

1. Perception is the reinstatement of previous experience with situations similar to the one at hand.

2. Perception is the interpretation of the many interrelationships within a given situation.

3. To a trained observer, the stimulus situation is richer in meaning than it is to a novice.

4. We tend to "see" things with which we are familiar and to "overlook" those things with which we are unfamiliar.

5. In perception we attribute a richness of meaning to almost any stimulus situation beyond that of the sensory data on hand at the moment.

6. The same stimulus pattern may give rise to different perceptual organizations at different times depending upon the total adjustment of the observer at the moment.

7. In everyday life we respond to isolated stimuli much more frequently than we do to patterns of stimuli.

8. We sometimes perceive movement under conditions when no movement really occurs.

9. Perception is determined in part by the activities in progress as well as by the stimulus situation itself.

10. Both interpretation and misinterpretation of the sensory data occur because we have learned to interpret the data correctly or incorrectly.

11. The size-weight illusion is an illustration of the dominance of one sensory modality over another.

12. An illusion is the erroneous perception of sensory data.

13. Vision is the only sense through which we can perceive an object at a distance.

14. Though we perceive things at a distance through our sense of sight, we are able to do so only because we have in the past had the co-operation of other senses with our sense of sight in similar situations.

15. Having learned from experience that as objects recede into the distance, they become less and less distinct, we thereupon estimate as "distant" those objects which appear to be indistinct.

16. Reversal of the normal shadow effects may cause an error in the perception of depth and distance.

17. When one looks at objects on a distant horizon, the eyes converge.

18. Kinesthetic cues are involved in depth perception.

19. The most important single factor in depth perception is the stimulation of unlike retinal elements of the two eyes.

20. The two-point limen is a measure of sensory acuity.

21. In reading, the eyes move smoothly from one end of the line to the other, pausing only at the punctuation marks.

22. Slow readers need merely to speed their eye movements to improve their reading skills.

23. With good readers, vision in reading is continuous, while poor readers can apprehend the material only while the eyes are at rest.

Multiple-choice items:

24. The stereoscope depends upon the principle of (1. interposition; 2. light and shade; 3. convergence; 4. binocular parallax; 5. accommodation).

25. A defect of the cornea of the eye so that all the refracting axes do not have the same curvature: (1. stereopsis; 2. myopia; 3. astigmatism; 4. presbyopia; 5. hypermetropia).

Essay question:

26. Discuss the statement: "In the blind, the sense of touch has been greatly developed."

CHAPTER 12

True-false items:

1. Illustrations of sensory discrimination are most often in terms of visual and auditory discriminations because these are the most important of our senses.

2. Auditory discrimination involves less spatial orientation to the sound source than does visual discrimination of depth and direction.

3. The semicircular canals are more important when listening to tones of high frequency than when listening to tones of low frequency.

4. Decrease in accurate tactual localization on the part of normal adults shows that the receptor mechanisms involved have lost their sensitivity.

5. The lower stimulus threshold values are higher in the middle frequency range than in the range of high frequencies.

6. The accuracy of localization of a tactual stimulus has been shown to depend upon the number of nerve fibers supplying the stimulated area.

7. A given difference in the strength of two stimuli is either too small for one to perceive or great enough to be continually evident.

8. A tone of 60 cycles per second must have a greater amplitude than one of 600 cycles per second if it is to be audible to the observer.

9. The intensity, or loudness, of a sound varies as the distance of the sound source from the listener.

10. Studies indicate that each vowel possesses a characteristic frequency which varies with the pitch of the voice.

11. The loss of hearing in one ear would greatly interfere with the localization of a sound source through auditory spatial discrimination.

12. In postrotational nystagmus, stimulation of the sensory endings in the semicircular canals is dominant over visual cues.

13. Noises possess some of the characteristics of tones.

14. A person may become, partially deaf and still experience no difficulty whatever in the interchange of conversation with other people.

15. Consonants have many audible partials above 20,000 cycles per second.

16. The fundamentals of a violin and a piano sounding the same note differ in wave length.

17. The distance traversed by a sound wave in one cycle is known as the wave length.

18. Any difference experienced in the quality of two sounds occurs because of the difference in the prominance of partials in the two sounds.

19. In spatial discrimination we make interpretations of distance partially in terms of the relative purity of tones.

20. The subordinate role played by the kinaesthetic sense in auditory spatial discrimination is unimportant.

21. The fact that normal adults are less accurate than children in tactual localization refutes the idea that tactual localization is a function of learning.

22. Rotational experiments indicate that the semicircular canals function to stimulate the muscular responses involved in maintaining equilibrium.

23. Postrotational nystagmus refers to the optical reflex demonstrated by a person after he has been rotated in a revolving chair.

Multiple-choice items:

24. Discrimination of the location of an object in space is best described as (1. an inborn ability present in all organisms; 2. an attribute of the object itself; 3. arising from the interrelation of sensory impressions experienced with similar situations in the past; 4. direct observation of an object in space).

25. The difference between the sound of a violin and that of a trumpet is primarily due to (1. the amplitude of air vibrations produced by each; 2. the frequency of the fundamental waves of each; 3. the difference in wave shapes produced by the two sound sources; 4. the interrelationships between visual and auditory sensations; 5. the energy values of the two sound sources.)

26. The physical term corresponding to loudness: (1. frequency; 2. wave length; 3. fundamental; 4. overtone; 5. amplitude).

27. The most important part of the ear involved in hearing is the: (1. ampula; 2. cochlea; 3. utricle; 4. sacculus; 5. vestibule).

Essay questions:

28. Describe the various factors that contribute to the localization of a sound source.

29. How may the organs of equilibrium assist or interfere with an aviator's discrimination of position? What other factors are available?

CHAPTER 13

True-false items:

1. Performance is the only criterion we have on the basis of which we can say learning has or has not occurred.

2. If a student studies his lesson for 20 minutes, we can say some learning has occurred without any further measure of performance.

3. Poor students often lack an adequate criterion on the basis of which to evaluate whether or not they have learned the material.

4. The rigor of learning criteria determines the rate at which forgetting will take place.

5. Those who learn slowly and those who learn quickly employ the same methods of learning; one of them merely progresses more slowly than the other.

6. Nonsense syllables are of value in studies of learning because each syllable is as novel as any other syllable on the list.

7. Ebbinghaus has shown that the amount of learning effort required is not directly proportional to the amount of material to be learned.

8. In the progressive-part method, each section of the material is learned separately.

9. There is an optimum spacing between learning periods if progress in learning is to be made most efficiently.

10. Distributed learning is a poor method because of the rapidity with which the material is forgotten between learning periods.

11. Students may continue to do poorly in their work even though they are familiar with the material of this chapter because they will fail to modify their behavior accordingly.

12. The more actively one participates in a learning situation, the more readily will he profit from the experience.

13. Unless we are somehow rewarded or punished at one time or another for the effort expended, little or no learning will occur.

14. Material learned for immediate recall will be less readily forgotten because the goal is an immediate one.

15. The kind of material and the purpose for which it is learned have little or no effect on the readiness with which learning will be achieved.

16. The best teacher is one who will expound in great detail all of the material to be covered in the course and tell the student how the material is to be interpreted.

17. Motor learning requires less effort than verbal learning and is more readily retained.

18. The presence of a plateau on a learning curve indicates a period of no further progress in learning.

19. Training in one field may definitely handicap learning in some other field.

20. There is little transfer of training other than methods of attacking a new problem.

21. Practice in skills with the right hand may lead to some improvement in skill using the left hand.

22. If you were to walk into a class and were asked to select the smartest student, your best guess would be to choose the youngest one.

23. Practice in learning is important primarily because it provides an opportunity for other factors in learning to become effective.

Problem:

24. Suppose you are given a poem (6 10-line stanzas) to be learned within 10 days. You find the poem a difficult one to comprehend, but you are to learn it well enough to recite it on any occasion at a moment's notice.

After you have read the problem, choose the most efficient course of action to follow in each of the given alternatives given below:

(*a*) (1) Learn it all at one sitting, or (2) devote yourself to it for 15 minutes a day until learned.
(*b*) (1) Spend part of each daily period reciting, or (2) spend all of each daily study period in reading.
(*c*) (1) Read and recite under a diversity of circumstances, or (2) read and recite in seclusion and quiet.
(*d*) (1) When reciting, recite to yourself, or (2) recite aloud to someone else.
(*e*) (1) Overlearn the poem by consecutive rereadings, or (2) overlearn by occasional rereadings.
(*f*) (1) Spend all of your learning time on this poem, or (2) spend part of your learning time on other poems.
(*g*) (1) Concentrate on rote memorization, or (2) spend part of your learning time on an understanding of its meaning.

Essay Question:

25. Discuss the various aspects of the problem of transfer of training.

CHAPTER 14

True-false items:

1. Any measure of learning is a measure of forgetting.

2. Recognition is a good method of measurement since the student is asked to do the same things he did in the learning situation itself.

3. Retention may be measured by using unaided recall immediately after learning and the recognition method after a lapse of time.

4. Unless the content of learning can be recalled, no learning has occurred.

5. We need give students but one test to measure how much of the lesson they have retained.

6. The use of completion-type questions on an examination is an illustration of measurement by the method of relearning.

7. The method of recognition is a more sensitive measure of retention than either aided or unaided recall.

8. Without recall it is usually assumed that you have either forgotten or had never learned the material in the first place.

9. The savings method eliminates the possibility of chance successes in the measurement of retention.

10. In the savings method, time is an unusually useful criterion for measurement.

11. The importance of methods of learning is reflected in the fact that these methods govern the rate at which the material is forgotten.

12. The measurement of how much you have retained depends upon what standard you have adopted as a criterion of learning.

13. Forgetting occurs very rapidly immediately after you stop studying the lesson.

14. Meaningful material is more readily retained than nonsense syllables; hence nonsense syllables are of little value in formulating any principles of learning.

15. Students are prone to forget their lessons quickly because they too often underlearn the material in the first place.

16. Overlearning pays because there is evidence to show that material 100% overlearned is retained much more than 100% better than material learned to the point of correctly anticipating each word of a series to be learned.

17. Intervening activities that are dissimilar to the learned material hamper the readiness with which the material is recalled much more than is the case if those activities are similar in content to the lesson.

18. In reminiscence we sometimes recall much more at a later period than we did immediately after learning.

19. Though students showed reminiscence in recalling the names of states on a second test, they forgot some of the states they had named on the first test, which proves that reminiscence and forgetting are synonymous.

20. Of two equated groups tested at intervals after a psychology lesson, the one tested on near-verbatim items did better than those tested by the same method using new items based on content.

21. The result obtained above proves that rote learning of facts is superior to the learning of generalizations and principles.

22. Forgetting is merely a passive process in which the effects of experience slowly fade away.

Essay questions:

23. Study the college situation and report what you find is helpful or a hindrance to remembering the material of your courses.

24. Even though you seem to have forgotten much of last year's courses, what have you gained from them? Give the evidence from psychological investigations.

CHAPTER 15

True-false items:

1. The response demanded by a given situation may be a response to the interrelationships within the situation rather than to any particular part of it.

2. Reasoning sometimes occurs in the absence of a problem.

3. Insight is said to have occurred when the errors in solving a problem suddenly drop out.

4. The solution of a problem by insight is a process that does not involve trial and error.

5. Reasoning consists in perceiving the problem.

6. The solution of a problem is sometimes blocked by the perseveration of habitual ways of problem solving.

7. In the early stages of learning to solve problems through the use of tools, the tool must be a part of the total situation if a monkey is to solve the problem successfully.

8. Much of thinking is the implicit manipulation of words and symbols.

9. Normal children three to four years of age exhibit behavior far superior to the ape in problem solving.

10. Verbalization is one form of trial and error in problem solving.

11. Manipulation of the keys in solving a multiple-choice problem is part of the process of thinking.

12. The solution of a problem requires that the problem solver react directly to the situation at hand.

13. Self-stimulation is an important phase of thinking.

14. When an individual' meets a situation for which he lacks an adequate response, reasoning will occur.

15. The greater one's command of symbols, the more adequately can he reach the solution of a problem.

16. A good reasoner sticks to one method of solving his problem until he is successful.

17. Thinking is merely a matter of muscle movements of one kind or another.

18. We have many preconceived ideas which may and often do interfere with learning and reasoning.

19. How you have solved previous problems will facilitate or hinder the solution of new problems.

20. Trial-and-error behavior in solving a problem is aimless, random, blind behavior through which we chance upon a solution to the problem.

21. Without any possibility for the use of symbols, there would be few if any short cuts in reasoning.

22. There is only one correct solution to any problem.

23. One need merely analyze the situation in order to solve any problem.

24. The brain of man accounts for his superiority over the ape in solving problems.

25. Reasoning is essentially a process of perceiving the interrelationships between an end to be attained and the means to that end.

Multiple-choice items:

26. The relation of thinking to learning may be stated as follows: (1. thinking is a process which we learn; 2. they are two different processes; 3. learning involves thinking, but thinking does not involve learning; 4. thinking is learning in a problem situation; 5. they are synonymous).

27. Creative thinking can be regarded as (1. the result of inspiration; 2. entirely different from trial-and-error performance; 3. dependent upon the application of reverie; 4. a reorganization of past experience which yields new meanings).

28. A student worked on a problem in algebra until midnight without success. The next morning the solution came promptly. Explanation:

(1. He could have solved it the night before; 2. leaving the problem for a few hours gave an opportunity for reorganization to occur; 3. the problem was solved by the subconscious during sleep; 4. sleep eliminated fatigue).

CHAPTER 16

True-false items:

1. Previous experience is both an asset and a liability in dealing with new problems to be solved.

2. Hull's experiment on concept formation refutes the idea that learning proceeds more readily from simple to complex than vice versa.

3. "Idea" and "concept" are synonymous terms.

4. Whenever an intelligent youngster meets something new, he forms a concept of what is new.

5. The situations presented in Hull's formation of concepts furnish items of the kind to include on an intelligence test.

6. The inventor, the artist, and the poet are similar in that their work is the result of inspiration.

7. Concept formation is of importance in providing an approach to the study of higher thought processes.

8. The formation of concepts depends upon the abilities to abstract and generalize from the facts at hand.

9. Most of us tend to think in terms of ready-made patterns and warp the facts to fit our expectations in certain situations.

10. This tendency to think in terms of ready-made patterns leads to careless observations and slipshod thinking.

11. Students sometimes fail the elementary course in psychology because of the tenacity with which they adhere to a preconceived idea that psychology is just common sense.

12. A person lacking in imagination fails to reorganize his past experience in ways that are pertinent to the problem at hand.

13. The best justification for taking a course in Latin or Greek is that these courses teach you to think.

14. People who have had a wide variety of experience enjoy an advantage over the rest of us because they possess a greater fund of experience to draw upon.

15. Many people with too little information enjoy the illusion of being able to deal adequately with new problems because their "minds are not stuffed with facts."

16. College teaches you to think insofar as it provides you with a diversity of material from which thinking can proceed along new lines.

17. The greatest danger in stereotyped thinking is the extent to which these habits of thinking become fixed and distort our conceptions of experience.

18. Our preferences for art, music, styles, and architecture are due to living in a social order in which these particular preferences happen to exist.

19. The best teaching attempts to provide the student with the setting and opportunities for solving problems of a kind he will meet later in life.

20. There is little or no relationship between the certainty of our beliefs and how well informed we are as to the facts.

Completion items:

21. The symbolic representation of something common to a number of objects, situations, or events is called ________.

22. A predisposition to react in a characteristic way toward any object, situation, or event is called ________.

23. The symbolic representation of an object, situation, or event is called ________.

24. A group of abstractions form a ________.

25. Most thinking is done by means of ________.

Essay questions:

26. Enumerate the qualities of good reasoning.

27. What factors contribute to our faulty thinking?

CHAPTER 17

True-false items:

1. The raw scores obtained on a test are virtually meaningless even though the test may be reliable and valid.

2. A really good psychological test must provide a wide scattering of scores; it must be reliable, valid, and must be standardized on the group for whom the test is intended, with adequate norms provided on the basis of which to interpret the test scores.

3. A reliable test may be virtually worthless.

4. Intelligence testing in practice is based upon the theory that with equal opportunities to profit from a common background of experience, people profit unequally from the opportunity revealing differences in ability.

5. A speed test takes advantage of the fact that intelligent people are quick to see the interrelationships involved in solving their problems.

6. We have better intelligence tests for adults than we have for children.

7. To be fair, a test must contain a large number of items from a variety of fields all fairly well represented in the environment of those for whom the test is intended.

8. Aptitude, achievement, and intelligence tests are all similar in that they are all measures of the degrees of brightness of those tested.

9. Unless we interpret the scores on a test in terms of how well other people perform on the same test, the results of testing are meaningless.

10. Unless a test measures consistently whatever it happens to measure, it is not valid.

11. All we have to do in order to determine whether or not a test is valid is to give the test and see if we get a scattering of scores.

12. The real justification for intelligence testing is the fact that the tests do predict what to expect in the way of success or failure in the future.

13. If on giving the test a second time to a group of people, we get essentially the same results we obtained the first time, the test is said to be reliable.

14. "Reliability" pertains only to factors within the test itself regardless of whether or not the test measures whatever we intended to measure.

15. There is no connection between occupational status and intelligence.

16. Group tests enable us to predict safely what achievements to expect from each individual taking the test.

17. The Binet test is suitable for use with any population.

18. An I.Q. is the ratio between a child's ability as shown on the test and the performance we expect of a child of his age on that test.

19. In selecting items for an intelligence test, one of the things we must do is to discover how much more difficult one item is than another.

20. More than half of the people are of average intelligence.

21. Performance on a form board is a measure of intelligence.

22. Intelligence test results prove the whites are superior to other racial groups.

23. Data gathered during World War I prove the Nordics are superior in intelligence to Mediterranean peoples.

24. The usual methods of employee selection are scientific procedures.

25. We have no way of testing the intelligence of illiterates.

26. To measure a complex of abilities requires a battery of tests.

27. High abilities disqualify an individual for many occupational opportunities.

28. Some vocations require such a complex of abilities that test batteries are inadequate for the selection of successful job applicants.

29. Patterns of interest short-cut the problem of aptitude testing in selected vocations.

30. It is safer to use aptitude tests for the purpose of discouraging people from entering certain occupations than to use them as a basis for specifying a given occupation for which they are especially well qualified.

Essay question:

31. If you wish to compare the intelligence of Negro and white children, how will you proceed? Try to set up a complete program, taking into account the objections already discussed.

CHAPTER 18

True-false items:

1. When we attempt to describe the personality of an individual, what we actually do is to investigate how well people like him.

2. Well-balanced people think with their feelings more often than they feel with their minds.

3. Since physique influences the development of personalities, we may classify personalities on the basis of physical characteristics.

4. One important aspect of an individual's personality is his ability to adjust himself continually to a constantly shifting environment.

5. Intelligent people have the most pleasing personalities.

6. Sensory defects may have a marked effect upon the personality of an individual.

7. Pleasing or displeasing personalities are developed in the school of experience, and cannot ordinarily be blamed upon heredity.

8. Personality is a composite of ways of behaving that have become habitual.

9. Immature personalities result from failure to learn the skills that are expected of one at that age level.

10. Adults cannot help having acquired certain habits as children, but they can ill afford to allow any of them to persist.

11. One is a victim of circumstances and can do little if anything to change his own personality.

12. Children should be protected from disappointments and hard knocks to aid them in avoiding the development of displeasing personalities.

13. A thorough "dressing down" with reference to your present personality development by someone who knows you is a good treatment for personality defects.

14. There are psychological tests on the basis of which we can predict marital happiness.

15. People are either honest or dishonest.

16. The experimental method is the most valid approach to the study of personality.

17. The interview in selecting employees is an illustration of the biographical method.

18. In the man-to-man method of personality measurement, the rater should not be well acquainted with the men to be rated.

19. Graphic rating scales are good because each rater interprets the scale in the same way.

20. A person who expresses himself fluently is apt to be overrated intellectually by other people.

21. The fewer the number of traits to be measured, the greater will be the accuracy of measurement of these traits.

22. All personality measurement is in terms of performance.

23. Each personality trait is a well-integrated way of behaving that is characteristic of an individual.

24. Psychologists have been more successful in constructing tests for the measurement of personality than for any other purpose.

25. Personality traits and types are synonymous.

26. It is characteristic of people that they need only know what to do and they modify their behavior accordingly.

Essay questions:

27. Examine carefully your own behavior in a number of situations. What may you conclude regarding your own adjustment? In what respects may it be improved? How will you set about accomplishing these adjustments?

28. What must we know about an individual before we can make an adequate statement regarding his personality? What methods may be used to obtain this information?

CHAPTER 19

True-false items:

1. A person is either normal or insane.

2. Psychological principles do not apply to explanations of insanity.

3. Through study of the insane we gain a better understanding of normal people.

4. The term "abnormal" applies to those who are either less or more able than most of us.

5. Insanity is an inherited characteristic, but feeble-mindedness is the result of an unfavorable environment.

6. Sanity or insanity is primarily a matter of interactions between an individual and his environment.

7. The insane are of low mentality as compared to the normal population.

8. The insane suffer from functional disorders in that whatever is wrong with them is more apparent than real.

9. One can easily account for the difference between normal and abnormal personalities.

10. Some experiences are so devastating to the personality as to cause anyone to go insane.

11. The composite of trials and tribulations one has experienced in the past is a precipitating cause for insanity.

12. Retrograde amnesia, which occurs in senile dementia, means that one tends to forget all the things that have happened recently and yet remember vividly those things that happened years ago.

13. Some mental disorders occur because of defects in structure.

14. Insane behavior is typically childish behavior.

15. There is no cure for insanity.

16. Normal people differ from the insane in that the insane have hallucinations, illusions, and delusions while the normal do not.

17. The insane retreat from the world of reality because they are unable or unwilling to face it.

18. Harmless escapes from reality need be indulged with caution and prudence.

19. People suffering from dementia praecox typically appear indifferent and display no emotion.

20. Most insanities are not of an intellectual but of an emotional nature.

21. Neurosis is behavior displayed by an otherwise normal individual who is unable to cope with problems that are of importance to him.

22. From experiments with animals we may conclude that a child may exhibit neurotic behavior if his parents are not consistent in their treatment of him.

Essay questions:

23. If a friend who exhibited neurotic symptoms came to you for help, what could you do to alleviate the situation?

24. What hygienic principles can you suggest for the prevention of neuroses in wartime?

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